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S. D. KIRKPATRICK, Editor

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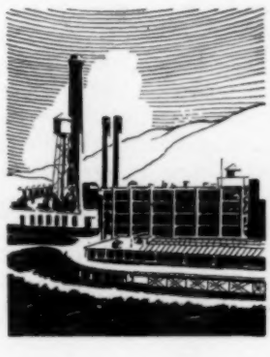
Is Chemical Industry Overorganized?

IN TIMES of trial, such as these, organizations as well as individuals are being tested. Some trade associations in the process industries have suffered drastic budgetary reductions which can only mean the curtailment of many important activities. A fortunate few prudently built up reserves in times of prosperity that will see them through the present crisis, but there are as many more that must now retire from the field. Only one or two continue unaffected, and, significantly enough, these are the associations that have concerned themselves almost exclusively with the practical, everyday problems of the industry. Their survival doubtless has in it a lesson for the other groups; but the failure of the weaker organizations is equally important, because it emphasizes a human shortcoming on the part of chemical management.

IS IT POSSIBLE that we have had too much individualism in industry? President Glenn Frank, of the University of Wisconsin, thinks so. "Individualism is important," he said recently, "only in terms of what it does to and for the individual. There is nothing sacred in the name. The fact is that the old and somewhat anarchaic individualism, which was a superb virtue in simpler pioneer days, has become a vice in this complicated, technical, interdependent age." Nowhere is this more evident than in the chemical business, for lately we have seen individualism carried to the extreme of ruthless destructive competition, for which the entire industry must suffer. Whoever said "Competition is the life of trade" (and his identity apparently is buried in well-deserved obscurity) must have had a very narrow viewpoint on life.



IS IT POSSIBLE that we have been overorganized in chemical industry? Has there been too great a division of responsibility with too specialized outlook on the problems of the industry? Merely on the basis of the products it manufactures, one large chemical company is eligible for membership in not less than twenty-five national trade associations. In addition, there are organizations in practically all of its consuming industries, as well as the more generalized associations, such as the chambers of commerce, and those for safety, better business, and tariff protection. Add to this the vast array of scientific, professional, and semi-professional societies, and the various local, state, and regional groups, and you have indeed a sorry picture of industrial gregariousness. Yet this is the situation that actually exists. Cooperation defeats its own purpose when it becomes weakened by excessive duplication of organizations.

WE NEED a single, strong association that can exert real leadership toward the common objectives of chemical industry. E. M. Allen, in his address at the recent banquet of the chemical industries, struck a keynote of outstanding importance. A merger of existing agencies, under the wise leadership that has been so conspicuous in the executive affairs of the Manufacturing Chemists' Association during the past year, will be the first and most logical step in this vital program. Then must come what Glenn Frank has chosen to call "followership"—ability to recognize and define the major issues and to follow wise leadership in a cooperative program that will protect and promote the best interests of the industry as a whole

EDITORIALS

JULY, 1931

A First Step Toward the Upturn

ENTHUSIASTIC acclaim of President Hoover's bold step in the war-debt crisis proved a sorely needed tonic for the commodity and security markets. Stock prices advanced by full 25 per cent in many instances and the buying of cotton, copper, and other basic commodities which are traded in the world's markets showed a healthy increase. The same spontaneous influence is perhaps not to be expected in the manufacturing industries, but a gradual improvement is distinctly in order. Chemical industry climbed out of the unprecedentedly low levels reached in December and January, and the next four months showed more than seasonal increase. In June the approach of hot weather and the mid-year inventories retarded this progress considerably, but the industry enters the last six months of 1931 with every prospect of improving on the corresponding period of 1930.

Tar Products Markets Deserve Careful Study

MANUFACTURERS of coal products have suffered substantial losses in byproduct credit during the past few years as a result of the large decline in the price of ammonium sulphate. There is some evidence that an equally serious attack upon their byproduct credit income will follow if present trends in coal-tar markets are not corrected. In fact, it is becoming increasingly difficult for those who desire to renew their tar sales contracts to secure as favorable a price for their production as would have seemed likely a few years ago.

There are numerous factors occasioning the present downward trend in tar prices. In the first place, tar is highly competitive with fuel oil, since a substantial percentage of both coal tar and water-gas tar must be burned as fuel, merely because the market for products of tar refining are more limited than tar supply. In the second place, the use of creosote oil for wood preservation has been recently curtailed significantly. Among other factors in this situation has been the inability of railroads generally to continue programs of replacing ties, poles, and posts on as vigorous a scale as during recent years. In part this decline in the use of treated wood by the common carriers has resulted from a completion of main-line programs; in part it has resulted from financial difficulties of the railroads themselves; in part it has come from a greater life for treated wood under practical service than was estimated when the programs of tie treatment were first undertaken.

There is no panacea for the economic ills of the tar refiner. However, the byproduct-oven operators, the tar refiners, and those generally interested in the welfare of the gas industry should cooperate in a study of the present situation affecting tar markets and tar prices. A certain few within the industry doubtless are well versed in all details of the present situation. But broader appreciation of these facts should be gained and all of the available talent should be sought for the active development of every practicable corrective measure which can be suggested. It would be a great misfortune for steel, for city gas, and for all other important industrial groups interested in coal products if as full a development as is economically possible were not made of coal tar for other uses than boiler fuel.

Continued Cooperation In Alcohol Formulation

ALCOTATE and aldehol in combination with alcohol did not prove a desirable perfume for general household use. This conclusion was not a surprising one, but it did raise a valid reason for objecting to the new completely denatured formulas when the resulting alcohol was to be used in lacquer, shellac, varnish, and paint. Workers applying these finishes found reasonable grounds for complaint of their working conditions; tenants desiring to utilize recently finished rooms also were justified in their protest.

This situation is now being corrected through the cordial cooperation of the chemists and administrative officials of the Bureau of Industrial Alcohol. Commissioner Doran has just announced a new modification of completely denatured formula No. 5 permitting the use of isopropanol with limited quantities of aldehol and alcotate and with the pleasantly odored terpineol as an added corrective for the less desirable odors. The chemical industries will deeply appreciate this further evidence of official helpfulness. If the results are at the outset not everything desired we can rest assured that still further development work will be done and every reasonable means afforded to make the formulas as satisfactory as possible for all types of legitimate use.

What the South Offers Pulp and Paper Manufacturers

RUSSIA holds less of a threat for the Canadian newsprint industry than does the southern part of the United States, in the opinion of Charles W. Boyce, secretary of the American Pulp and Paper Association. "Canada need fear no northern forest country," he recently told the technical section of the Canadian association; "Canada's troubles will come from other sources when pulpwood is cheaper." Just how soon such competition will become serious is not yet apparent, but for at least a year the whole American South has been carefully studied by pulp and paper manufacturers. They have found, among other things, new low-cost raw material in a territory where transportation costs are attractively low and operating costs unusually favorable.

It has been estimated that the present wooded area in the South covers over 220,000 acres, and the pine area alone comprises over 114,000. Much of this is slash pine, from the sapwood of which Dr. Herty and others have recently made a good grade of white paper as well as excellent newsprint. Due to the long growing

season, these trees attain pulpwood size in 15 to 18 years, which makes reforestation profitable. Among other advantages of the pine in the territory comprising the South Atlantic and Gulf Coastal plains, are the unusually low cost of pulpwood and the greater yield of pulp per cord of wood. And in contrast to the spruce of northern forests, which yields only pulpwood, the Southern slash and longleaf varieties of pine may produce additional income from naval stores.

The cost of transporting the finished paper product to the market is an important element in the selection of a paper-mill site. Warren T. White, writing in the *Manufacturers' Record,* states that a regional comparison of pulpwood and transportation costs shows that the South Atlantic territory enjoys an average differential over locations in New York and the New England states of $7.85 per 1,000 pounds of paper produced.

In addition to cheap pulpwood and favorable transportation, this territory contains many streams that supply an abundance of fresh water, while soda, sulphur, and the other chemical raw materials are readily obtainable at favorable costs. The mild climate makes it unnecessary to store large supplies of pulpwood. And hydro-electric power and fuel are cheap and available in most localities in the area.

Thus the south, which uses more than twice as much paper as it produces, offers a practically inexhaustible supply of a new raw material for its production, at an unusually low price. This set of conditions is especially inviting at a time when the reduced prices of finished products make it necessary to manufacture on a more economical basis.

A Hearty Welcome to Omicron Chi Epsilon

IT is with some hesitation that we approve the addition of another honorary fraternity to the already long list of Greek letter organizations. Yet when one considers that the sciences and arts of chemistry and electrochemistry, physics and electrical engineering—to mention but a few—have long had their national societies, it seems strange that up to now there has been no strictly chemical engineering organization in our universities and colleges.

The missing element in this periodic table of Hellenic symbols has now been supplied, however, by students of the University of Illinois, which institution incidentally, was the birthplace in 1889 of the oldest honorary chemical fraternity, Phi Lambda Upsilon. But Omicron Chi Epsilon was formed to promote high scholarship and professional feeling primarily among the undergraduates in chemical engineering. Three seniors, three juniors, one graduate, and several members of the faculty have been elected to membership. Next year a number of honorary memberships are to be bestowed and invitations to establish other chapters will be issued to certain universities and colleges in which there are chemical engineering courses.

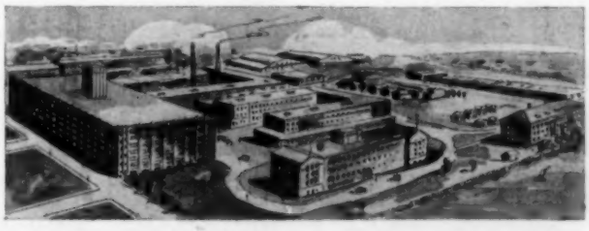
This move reflects the awakened consciousness of chemical engineering in our educational institutions. It will help promote professional solidarity in a group that in the old days was too often dubbed as hybrids—recognized by neither brother chemists in Phi Beta Kappa nor brother engineers in Tau Beta Pi. Omicron Chi Epsilon can fill a long-felt need. In extending our congratulations to the small group at Illinois, it is with the hope and expectation that a large and substantial growth is in immediate prospect.

Erecting Signposts To the Better Mousetraps

OF course, the fable about that path which the world beats to the maker of even the better mousetrap will always hold, but its author presupposed that it would be applied with some understanding. He didn't need to add that it would be populated more quickly if mouth-to-ear recommendation could be accelerated, or that a still better mousetrap might later start the world on a new path to some other maker. And he assumed that the functioning of a mousetrap was within the immediate grasp of its clientele, without requiring tedious investigation.

The complexity of the chemical market nowadays in nowise overturns this concept of profitable quality—that is, of superior performance. But of late years the best material for some operation has been unable simply to wait until industry avidly clamored for it. By that time it had probably been surpassed and made obsolete by some new material, less modestly content to await its call. And, after all, it was expecting a good deal of the industrial world to reckon with its thorough investigation of the possibilities of each new product. For things had gone along for centuries without it, and besides, the product ought to know its own excuse for existence.

This excuse is fairly obvious in the price of standard products: the salesman need only point out his company's advantage. But with the "standard" product becoming a rarity, even among heavy chemicals, a price list and a pleasant personality are scarcely adequate sales equipment. In an article in this issue, Raymond B. Ladoo suggests not only some of the present obstacles in the industrial chemical market but also a sound methodology for progressing over them. Actually his method amounts to commercial research, which has been expounded frequently in these pages. For commercial research it is which tells how its mousetrap functions, why it is cheaper in the end than others, under which conditions it is best applied, what else it does simultaneously (such as catch rats too), and finally, how many houses in the community are rodent-ridden anyway.



No longer need the chemical plant be the ugly duckling of the industrial community. Here the best of the architect's art has transformed what might have been just another alkali works into a beautiful assembly, well suited to its unique surroundings.

Chemical Plant Combines Beauty and Efficiency

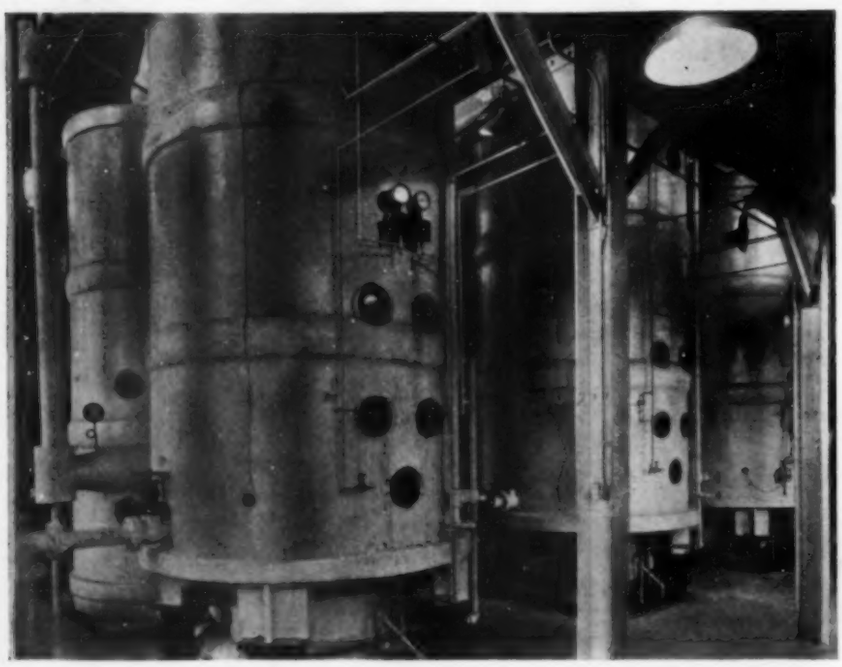
By PAUL D. V. MANNING
Pacific Coast Editor, Chem. & Met.

AS ONE whose business it is to lay out and design plants and apparatus, every chemical engineer dreams of a perfect plant—a place not only of efficiency but also of beauty. The near accomplishment of such a dream has been the lot of the engineers of the Hooker Electrochemical Co. in the construction of their electrolytic chlorine and caustic soda plant at Tacoma, Wash. In accordance with the modern theory of plant design, that beauty is not inconsistent with efficiency but in fact tends to increase efficiency, the Hooker engineers worked closely with the architects, McKim, Mead & White, who are responsible for the design of the building exteriors and their decoration. Together they matched the ideal practical layout evolved by the electrochemical company's engineers into a set of buildings which could stand by themselves on their artistic merit alone. It was thus found possible to erect a chemical plant, usually a conglomeration of ugly buildings, tanks, and pipes, so that it is one of the most important architectural features of the city of Tacoma.

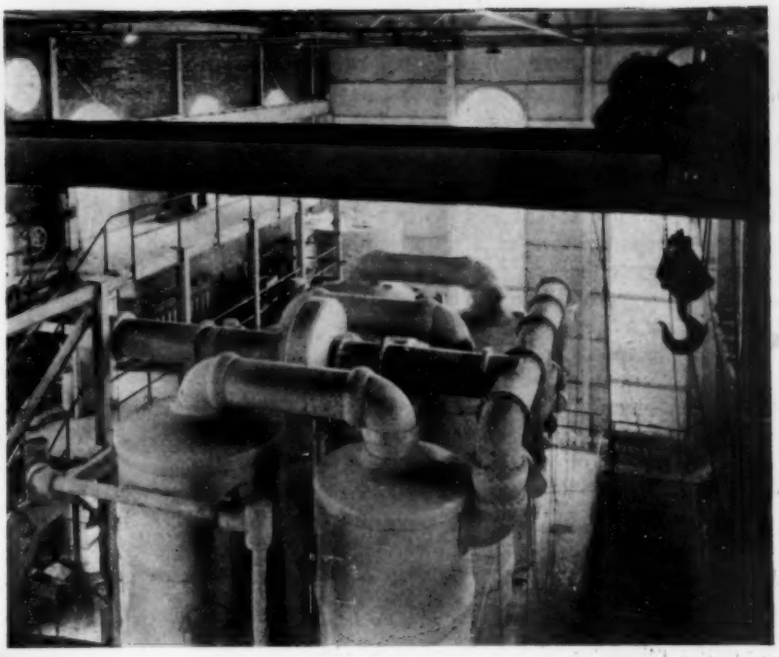
From waterfront to street entrance, from the green lawn around the grounds to the top of the gilded dome of the caustic building, this plant is a marvel of automatic operation and beautiful construction. Its operating force has demonstrated what can be done toward maintaining its good appearance, so that at the end of its first two years of production it is more of a thing of beauty than ever. Snow-covered Mount Rainier, seen over the foothills, forms an impressive background for this unit.

The Tacoma plant was put in operation in February, 1929, just 165 days after construction was begun. Previous to this, exhaustive surveys had been made into every phase of the Pacific Coast region and contracts had been made disposing of a substantial part of the proposed plant's output before any work was started. In addition to this the rapidly growing paper and pulp industry of the Pacific Northwest made the installation of a chlorine plant almost imperative, and in less than two years, in spite of the general business depression, the plant was operating at full capacity.

Further south the oil industry created an increasing demand for both



Caustic Soda Evaporators: Note the Cleanliness of the Building and Equipment



Modern Equipment Gives a Maximum Evaporation Efficiency with a minimum of labor

Boiler House, Pipe Bridge, Caustic Building, and Cell-Liquor Storage Tank at the Hooker Tacoma Plant

solid and liquid caustic soda, producing what at first seemed to be an awkward situation where chlorine was needed in Oregon and Washington and caustic soda in southern California. The distance between these two consuming centers together with the existence of competing plants already operating in central and southern California made the economic marketing of caustic soda, particularly in liquid form, very dubious. However, by installing a storage and distributing plant on Los Angeles Harbor the problem has been worked out satisfactorily and in addition proper technical service can be given to the large number of consumers in the southern California territory.

The plant is on a 20-acre tract on the East Tacoma tide flats, having a waterfront of 1,200 ft. on the Hylebos waterway. At present there are two finely equipped docks with 37 ft. of water at low mean tide. This allows ocean-going vessels to unload the basic raw material, salt, and to take on the finished products for distribution. Railroad facilities are afforded by sidings connecting direct with four of the large trans-continental and Pacific Coast railroads, including the Great Northern; Northern Pacific, Chicago, Milwaukee, St. Paul, and Pacific; and the Union Pacific. Obviously this plant has been conceived with a far-sighted view of future development on the coast as well as to care for the demands of the present and immediate future. The docking facilities for ocean-going freighters point to large export shipments in the future.

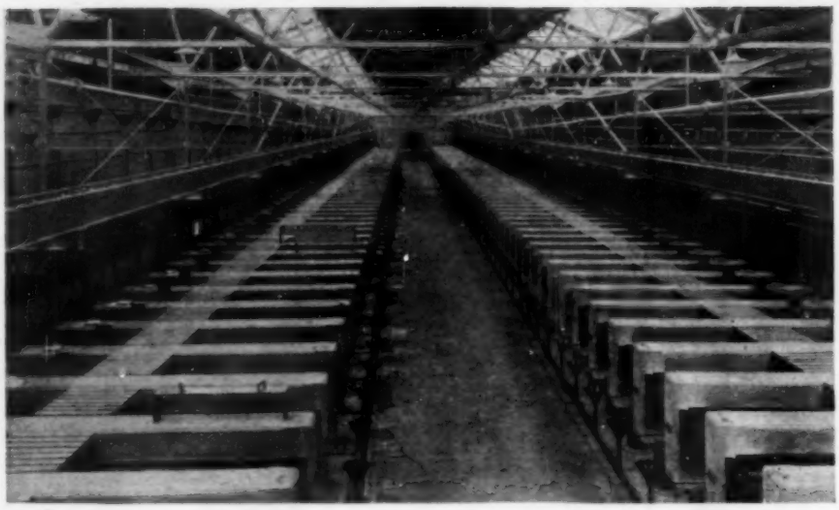
That important necessity of the electrolytic plant, cheap power, is supplied by the Cushman municipal hydro-electric plant of Tacoma. It is brought in over duplicate lines at 14,000 volts to the city-owned transformers on the grounds. There the voltage is reduced to 350–440 volts, at which it is delivered to the converters and the plant motor power lines. In this connection it is interesting that during the power shortage at the beginning of 1930, E. H. Hooker was largely instrumental in arranging with the Navy Department whereby the U.S.S. "Lexington" supplied much-needed power to the municipal lines from her oil-driven generating system.

Westinghouse synchronous converters furnish direct current to the electrolytic cells and are so arranged as to be automatically protected against rise in temperature, line disturbances, and bearing trouble. The converter room is seen through a glass wall at the end of the cell house and semaphores on the converters together with easily read meters and audible and visual warning signals keep the cell-house operator fully informed on the details of his power supply, while a dual-control system allows him to govern their operation.

All steam used in the plant is carefully metered and is derived from crude oil and hog fuel through the medium of Babcock & Wilcox water-tube boilers operating at 150 lb. pressure. Large tanks enable the plant to store oil direct from tankers, which tie up at the company dock. A 200-ft. stack removes the combustion gases.

What appeared likely to be a rather difficult problem, the supply of a proper grade of reasonably priced salt, turned out to be comparatively simple. Salt may arrive in water-borne shipments of from 2,000 to 8,000 tons, either from foreign shores or from San Francisco Bay, according to the governing conditions when supplies are required. The salt is transferred from the ship to storage tanks by means of clamshell cranes and Pioneer belt conveyors, so arranged that it can be carried from any part of the dock to any part of the storage system at will. The brine is made in these tanks and transferred to a brine-storage system, and from there it passes to the electrolytic cells as needed.

The electrolysis of the brine is carried out in Hooker patented cells of the diaphragm type which have been

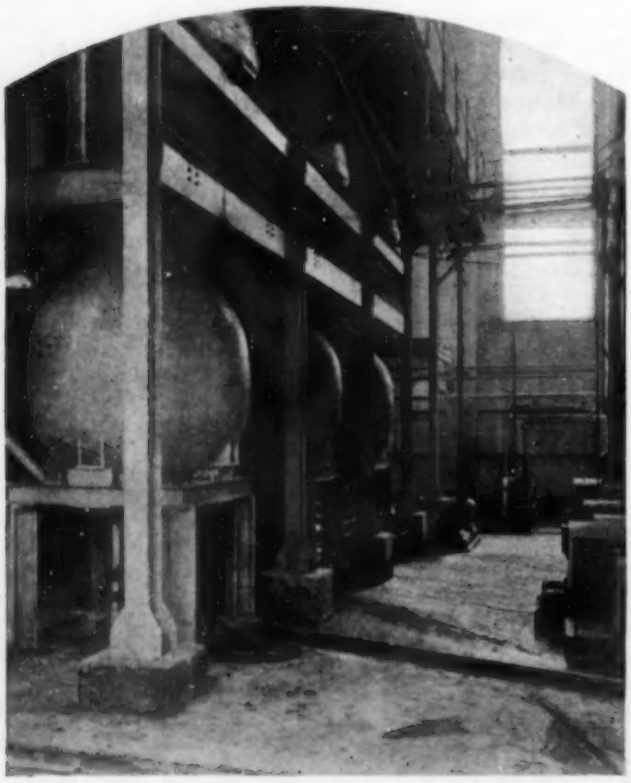


Modified Hooker Cells of the Diaphragm Type Give High Output Per Unit of Floor Area Covered

gradually improved and modified, at the parent plant at Niagara Falls, until they have taken the highly efficient form now in use at Tacoma. Not only do these cells operate at a remarkably high energy efficiency but their constant and gradual improvement has resulted in a high output of chlorine and caustic soda per unit of floor area covered, a most important economy in plant construction. The amperage on the cells may be varied within wide limits, as the required output may dictate, without seriously impairing the efficiency or life of the cell. Acheson graphite anodes are used and perforated iron cathodes with asbestos diaphragms. The net result of some 25 years of constant improvement is a high-efficiency cell of long life which produces a caustic liquor of relatively high strength, and since these cells are capable of handling a high load, a great economy of space is effected.

In the operation of the cells the wet chlorine gas is removed at the rear and the hydrogen from the cathode flows through water-sealed connections to the pumping system. The electrolyzed liquor is delivered to tanks from which it is pumped to storage.

Modern engineering skill has made it possible to remove the water and salt from the caustic liquors in a highly efficient manner and many of the old hazards and discomforts of the process have been eliminated. The necessity for highly skilled process workers with the power of tying up the plant at any moment because of their specialized knowledge and technique is now eliminated and a system of continuous, largely automatic, apparatus and machinery takes the caustic liquors and delivers the solid product or solution at the other end.



Caustic Evaporator Salt Traps With Caustic Sump Pump in Background

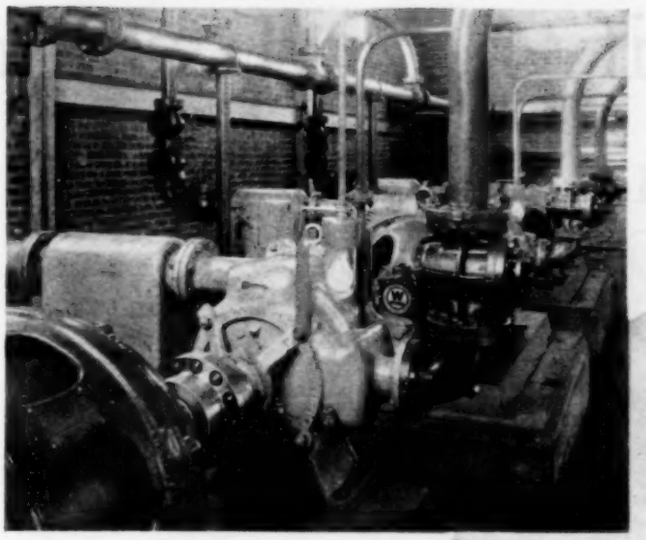
At Tacoma, high-speed evaporators are used and the control is worked out on a panel containing ammeters for the pump control, Bailey flow meters, leakage meters on the condenser water, and other equipment. The salt removed is washed and returned to the brine system. The modern apparatus used gives a maximum evaporation efficiency with a minimum of labor.

While Pacific Coast markets use liquid caustic soda solution for the most part, the entire production of this plant can be fused into solid form in the oil-fired pots provided for that purpose. The plant manufactures its own drums and the fused caustic is pumped into these by a movable filler serving several drums at a time. A drum flaker and suitable weighers are available for manufacturing flake caustic. As mentioned before, the company maintains a distribution station on Los Angeles Harbor where caustic liquor is stored in transit and finally distributed.

The wet chlorine from the cell room is carried to the chlorine building under slight suction through tile pipes. It is then led through brine-refrigerated coolers designed to remove moisture. At this point the chlorine is dried over concentrated sulphuric acid and from then on it is handled in iron pipe lines as easily as ordinary gas.

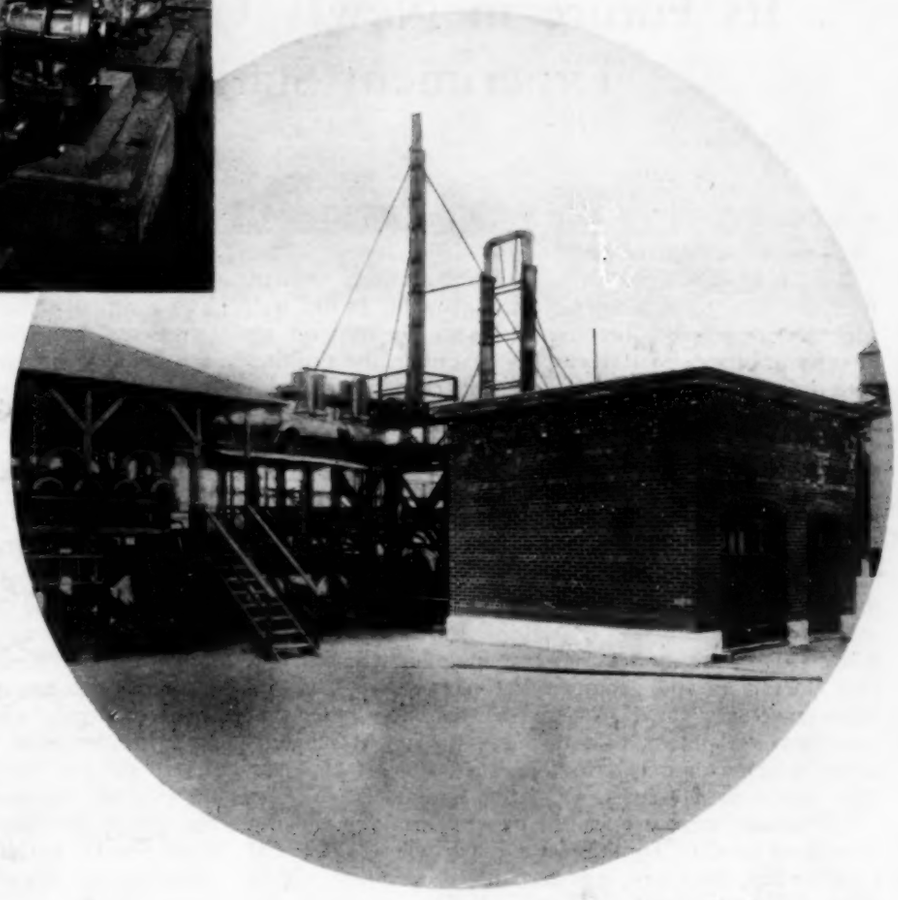
The dry gas is subjected to a combined pressure and freezing which causes it to liquefy, the air present being blown off into other processes together with its complement of chlorine. All control of the chlorine system is centralized with the necessary instruments in the compressor room and each shift tests all the valves in the system upon starting to work. Refrigeration is provided by Kroeschell carbon-dioxide units, which, due to the high-pressure involved, are of rugged construction and have proved eminently satisfactory for the purpose.

The greatest care is taken throughout the entire handling of the chlorine to remove all traces of impurity and every chlorine container is rigorously examined and cleaned. The chlorine-cylinder loading house cares for cylinder and valve testing and repairs and also takes care of the larger units, both ton containers and tank cars. Fresh valves always are used on each container before shipment and every cylinder is carefully examined inside by means of an electric light. Track scales are pro-



Chlorine Is Handled by Nash Hytor Turbo-Compressors

Hydrochloric Acid Plant; Butner Building on Right, Blow Tanks in Center and Tourills on Left. Above the Blow Tanks Are the Scrubbers and Vent Stacks

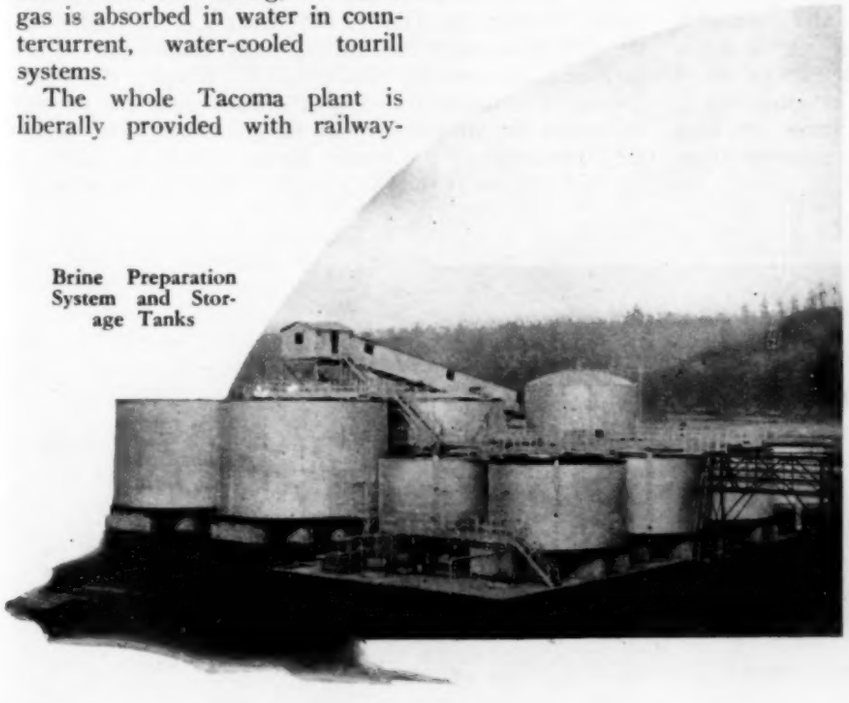


vided for weighing the tank cars The rigorous care given to this part of the process insures the chlorine user of smooth service.

Part of the chlorine and part of the hydrogen given off by the electrolytic cells are combined to form muriatic acid which is shipped out in carboys and rubber-lined tank cars. This acid is of extreme purity and, due to the almost complete absence of iron, is water-white in color; so clear in fact that several times in the past it has been mistaken for water.

The hydrogen is forced into a counterbalanced gasometer so arranged that if the hydrogen supply is interrupted, trips automatically come into operation, shutting off the supply and actuating alarms. After cooling, the HCl gas is absorbed in water in countercurrent, water-cooled tourill systems.

The whole Tacoma plant is liberally provided with railway-switching facilities, arranged not only to take care of present needs but also to serve projected enlargements equally efficiently. An 8-ton Plymouth gas locomotive is used for handling cars around the yard.



Brine Preparation System and Storage Tanks

All units of both buildings and apparatus are arranged for future expansion so as to build up a consistent scheme in which the plant at any period of its growth will appear as a finished, properly balanced architectural whole. Without any loss in practical operation, those details of the chemical plant which usually stand out as unsightly masses of pipes and tanks have been carefully put in the background and covered by a set of buildings. This has been made possible by many years of untiring effort by the engineers and executives at the parent plant, where one of the largest electrolytic plants in the country has been built around the first experimental Townsend cell.

Fortifying a Technical In

Hercules Powder Co. Intrenches Its Future in Newly Completed Experiment Station

WHEN the Hercules Powder Co. became an independent organization in 1913, it was in the unique position of a maturity attained without facilities for independent technical growth. It did not, for several reasons, become necessary to rely on an immediate program of research to maintain the position that the company occupied as it embarked on its independent career. Nevertheless, the management recognized its operations to be based wholly on chemical manufacture and, altogether in accord with its deliberate conservatism, soon concerned itself with its technical foundations. As a result the Hercules Experimental Station came into being in 1915 as an organization of about 20 persons situated at Kenvil, N. J. From this modest institution gradually grew a complex of several laboratories and a staff of 160 in 1930—testimony that chemical research had long become an integral factor in the company's operations. And its importance was rated so high that its next expansion was converted into a thorough and farsighted rehabilitation which culminated in the completion of the new laboratories at Hercules, Del., this summer.

The immediate cause for the new undertaking was the increasing need of facilities at Kenvil, where additional construction, therefore, was becoming imperative. After some deliberation it was finally decided to apply the prospective costs toward an entirely modern new construction, in a more accessible location, and adaptable to any future projects that might become feasible. About five miles west of Wilmington, a tract of more than 300 acres was acquired and on its eminence a building site was laid out. Eleven structures are now completed and most of the staff was transferred from Kenvil in April.

Since the new project is, after all, a reflection of the company's technical personnel, a more detailed description will be prefaced by a word on the organization. The company's manufacture is divided into several departments, including explosives, naval stores, cellulose, and cellulose products, each headed by a general manager and with superintendents stationed at the various plants. Research and technology likewise constitute a department under G. M. Norman, technical director, and its plant, the Experiment Station, is in turn headed by H. E. Kaiser. The laboratory, in its cooperative function with all other groups, is organized in corresponding, and additional service, units, led by assistant directors of the laboratory.

Both the new Experiment Station itself and any fresh research undertaking display the deliberate outlook of the company as a whole. Conference of the technical director and the director of the department involved decide whether a project shall be undertaken or continued, and how much outlay it may consume. These projects originate in the course of manufacture or may be conceived by any member of the staff and brought under discussion. The activities of the Experiment Station are divided between fundamental research, experimental process and semi-plant work, and technical sales service.

For the entire plans and construction of the Experiment Station, the Hercules Powder Co. depended on its own permanent engineering staff, a division of the technical department, under G. E. Ramer, chief engineer. The drawing and photographs show the present extent of the laboratory with its completed brick buildings but without the power house, which is located a quarter mile away, beside a creek. The three-story main

Former Laboratories of the Hercules Powder Co. at Kenvil, N. J., Outgrown by the Demands of Research

al Institution at Its Foundations

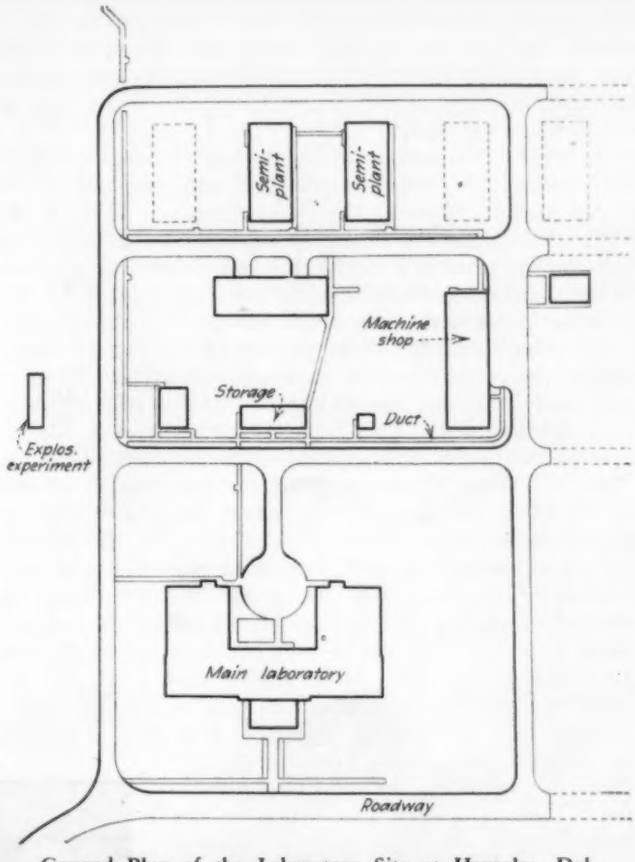
Main Laboratory of New Hercules Experiment Station. At the Left Are G. M. Norman, Technical Director of the Company, and H. E. Kaiser, Director of the Laboratories

building, in which all chemical research, the extensive library, and offices are located, is supplemented in the rear by smaller structures housing a machine shop, storage units, semi-plant facilities, and high-pressure and explosives experiment chambers.

Power and water are supplied from the power house by means of lines laid in concrete ducts, the covers of which form a pavement around the grounds. This removable pavement, of course, gives access to the lines at any desirable point. A channel in the bottom of the ducts, with a constant, slight inclination downhill, provides effluence not only for dust and water seepage but also for waste waters from all the buildings.

All water used in the laboratory comes from the creek at the power house, where it eventually returns by way of the ducts after septic-tank treatment on the grounds. Within the buildings advantage has been taken of the best available materials such as stoneware pipes, chromium-steel fixtures, and the like. Of special interest are the built-out "closets," in the separate rooms, which accessibly house the various ducts and lines as they pass from floor to floor. Excellent lighting at all times is obtained by the southern exposure, and communication is facilitated by private telephone with the main office at Wilmington.

Not all research units have been transferred to the new station yet, but they will follow in due convenience. Control laboratories will remain at the plants to maintain immediate contact with production. The new site, with its large expanse and excellent location, meanwhile stands ready to accommodate not only any enlargement of the laboratory but also such projects as the course of time may bring with it.



Ground Plan of the Laboratory Site at Hercules, Del., and Airplane View Below

How to Improve Durability Of Chromium Plate

By R. J. PIERSOL

Consulting Engineer
Pittsburgh, Pa.

DOUBTLESS no other electroplating development has so quickly and thoroughly caught the popular imagination as chromium plate. Almost over night the sales talk of automobile and plumbing equipment dealers centered around chrome, heralded as the miracle metal. The public immediately became sold on the promise that chromium plate is everlasting. Individuals who purchased chromium-plated automobiles or had their bathrooms refinished with chromium-plated fixtures often were astonished in a short time either to find that the chromium had peeled from certain parts or that the rust was showing through the chromium. In fact, complaints have been so consistent that many manufacturers regret that they jumped into chromium plating with their eyes shut.

A scientific investigation of the performance of electrodeposited chromium clearly indicates that there is a happy medium between the two extremes. There is no basis of fact for the promoter's promises that commercial chrome plate is imperishable and a cure for all evils in metal finishing. Likewise there is little excuse for the inferior chromium plate which has flooded the market.

In order to paint a clear picture of the factors influencing the permanency of chromium-plated articles it is necessary to present the background of this recent industrial development. This background includes a discussion of the beneficial competition due to stainless alloys. This is followed by a study of the preparation of the article to be chromium-plated, which includes design of the article, selection of the foundation metal, cleaning of the piece, and use of an intermediate plate for rust prevention. Also the importance of the technique of chromium plating is emphasized, including the advantages of eliminating the human equation by the use of automatic equipment. It is shown that much of the inferior chromium plate is due to lack of scientific engineering, first, in planning the article to be plated; second, in designing the plating department; and third, in organizing the operating personnel. Thus it is seen that vision by the manufacturer in marketing a superior chromium-plated product will be beneficial to chromium as compared to competitive finishes.

At present the most dangerous competitors of chromium plate are stainless alloys. Several alloys, high in nickel and chromium, have been developed recently, which can be drawn almost as readily as low-carbon iron. For over a year the Ford automobile has used stainless alloys for radiator shells, lamps, and hub caps These require a deep drawing operation And certain of the expensive types of cars are said to be about to adopt chrome-nickel alloy trimmings, including bumper bars.

From the standpoint of the user there has been little dissatisfaction with stainless alloys. Manufacturers of these alloy parts have had considerable grief. The principal metallurgical problem has been to relieve the internal stresses set up when drawing the alloy sheet into shapes having sharp edges or corners.

The most important mechanical problem has been the polishing of the alloys. It has been necessary to develop an entirely new technique. There are indications that this polishing difficulty will be solved by the use of completely automatic grinding, polishing, and coloring equipment.

The base price of stainless alloys is high and will remain so, because of the large percentage of nickel and chromium. It is stated that at present the manufacturing cost of a chrome-nickel alloy radiator shell is higher than that of a chromium-plated radiator shell. Since the cost of polishing these alloys is still excessive, it is probable that with future developments the cost of an alloy radiator shell will be comparable with a chromium-plated radiator shell.

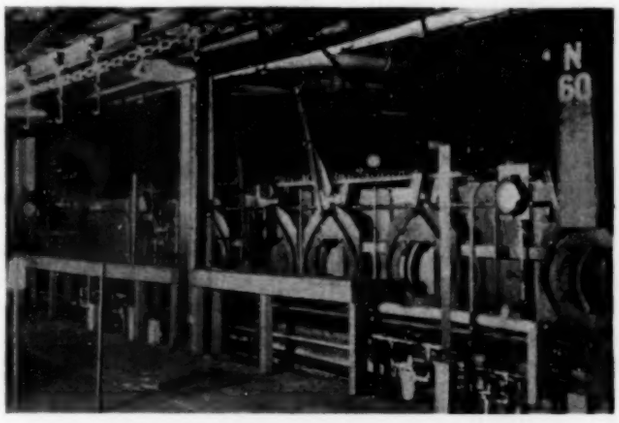
In the case of a bumper bar the advantages of alloys are obvious. Due to parking in congested districts, a chromium-plated bumper bar will be scratched regardless of the carefulness of the owner. These scratches immediately permit rusting of the foundation steel.

Commercial chromium plate averages less than ten-millionths of an inch in thickness. Therefore enthusiastic polishing with an abrasive on the part of the owner soon will wear through the film of chromium. As compared to this, alloy steel may be polished indefinitely, as it is solid rather than a thin plate.

Automatic Equipment for Copper- and Nickel-Plating Bumper Bars Previous to Chromium Plating

The invasion of alloys into the field of chromium plate is fortunate for the chromium-plating industry, because they form a definite standard of durability which chromium-plated articles must maintain. Previously the criterion for chromium trimmings on an automobile was their appearance at the time of purchase. The new standard for chrome must be its permanency in reference to chrome-nickel steel.

In order to make a durable chromium-plated article, it is necessary to design the article with the knowledge of certain limitations peculiar to chromium. Ordinary electroplates, such as nickel, copper, silver, and cadmium, have good distribution of metal over an irregular shaped article. This tendency toward uniformity of thickness is due to the fact that more metal is deposited in a recess and less on a projection, than would be expected. This is caused by an increased polarization and a decreased current efficiency with an increase of current density. The tendency in chromium plating is exactly the opposite. There is an exaggeration of the contour of the foundation metal, with no chromium in deep



Side of Automatic Machine Showing Busbar Connections and Driving Mechanism

recesses and excessive chromium on the projections. This is due to (*a*) an increased current efficiency with an increased current density; (*b*) no increase of polarization with an increased current density; and (*c*) a limiting value of current density below which there is no deposition of chromium.

Another unique property of chromium plating is due to the fact that there is a narrow range of current density which produces a bright deposit. The physical characteristics of chromium outside of this bright range are such as to produce an inferior article, although the dull chromium may be polished to a high luster. Even if the polished chromium plate were durable, it is unsightly and costly, due to the extreme difficulty in coloring chromium.

A third property of a chromic-acid solution is its oxidizing strength. It is next to impossible to rinse inside recesses free from chromic acid. This trapped acid will ooze out each time the article is wet, not only oxidizing the foundation metal but dissolving the chromium plate as well. And a fourth characteristic of chromium is its high coefficient of light reflection, approximately 70 per cent, with a color resembling that of polished platinum.

The durability of chromium necessitates a definite minimum of thickness in the recessed parts of an article, the exact value of which is dependent on the service to which the article is to be subjected. Thus it is essential to design the article so that it is possible to obtain a protective thickness of chromium at any part of the surface without producing a burnt deposit at some other part of the surface. This requires a contour free from deep recesses and sharp corners or edges. For instance, in designing a handle for a pitcher, the inside angle should be filleted and should not be less than 90 deg. It is impossible to produce a durable article in which the edge is beaded for mechanical strength, such as a tray, unless the edge is soldered solution-tight.

Due to the high reflection coefficient of chromium, a greater beauty is obtained by designing the article with facets, similar to a cut diamond. Likewise the glare is eliminated by plating on a hammered surface rather than a smooth surface. As yet this point has not been appreciated fully by manufacturers.

It is emphasized that one fundamental reason for lack of durability in many classes of chromium-plated articles is the fact that the producer has not realized that his designer must cooperate with an authority in the chromium field.

A lack of understanding as to specifications for the foundation metal has caused grief both to the manufacturer and the consumer of chromium-plated articles. Cast iron and hot rolled iron usually have porous surfaces. The pores are reproduced by the electroplates, with the result that when the article is subjected to weathering, the foundation metal rusts beneath the plate. This rust may corrode the plate within a period of a few weeks.

Likewise cast iron may be high in free carbon. These carbon particles, at the surface of the metal, act as electrical insulators. Therefore they must be bridged over by the plate, resulting in poor adhesion between the foundation metal and the electroplate as well as an extremely porous deposit of metal.

The use of brass as a foundation metal on which chromium is plated directly has been the chief cause of lack of durability of plumbing fixtures. This is due to the zincification of the chromium by the zinc in the brass. If the chromium deposit is thin, in a few months the chromium will disappear entirely. If the chromium is thick, a dark-colored chromium-zinc alloy is formed between the chromium and the brass. Since this material is non-adhesive, it results in subsequent peeling of the chromium.

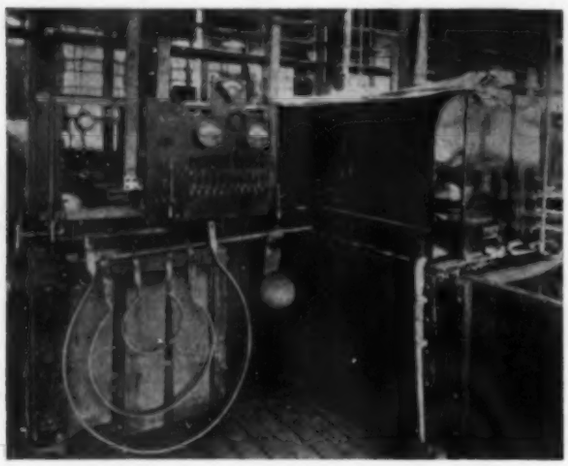
EVEN now many platers advise that chromium be plated directly on brass. This is illustrated by the experience of a large manufacturer of plumbing fixtures. At the start the company was advised by its own chromium man to plate chromium directly on brass. As would be expected, under bathroom conditions, these fixtures had to be replaced every few months. Refusing to admit his error, this man developed a new brass alloy, containing 5 per cent zinc instead of 20 per cent zinc, continuing to plate chromium directly on his new brass alloy. This did not solve the problem, but only put off the evil day. Still the man maintained he was right, although he advised the company to adopt an intermediate plate of nickel in order to improve the color of the chromium.

The effect of zinc in nickel silver and various white metals is analogous to that of the zinc in brass. Also there are certain indications that a few other metals, such as antimony, react with chromium. There is a difference of opinion as to the possibility of an electrochemical reaction when chromium is plated directly on aluminum. At present this point is of only academic interest, due to the technical difficulties in plating a

bright adhesive deposit of chromium directly on aluminum. In general, a foundation metal should be selected possessing a fine grained non-porous structure, which is homogeneous throughout.

One of the early difficulties in chromium plating was poor adhesion, with resultant peeling of the intermediate plate from the foundation metal. This trouble has been solved to a great extent by the adoption of electric cleaning. With previous methods of cleaning and scrubbing it was seldom possible to obtain a physically clean surface, as each successive cleaner left a film on the surface of the metal.

Electrocleaning may be either cathodic or anodic; but usually cathodic is followed by anodic. The solution may



Chromium Plating Unit for Reflector, Up to 36 In. Diameter, Showing Racks and Chromium Tank

be either acid or alkaline, depending on the metal to be cleaned. It is desirable that the article to be cleaned be neither etched excessively nor tarnished. The operating variables are current density, temperature of solution, concentration of solution, and time of cleaning. It is essential that these be controlled closely.

In theory, the process of electrocleaning consists in electrochemical solubility, the removal of foreign matter by the copious evolution of liberated gases, and in many cases the abrasive action of an inert ingredient such as kieselguhr. It may be noted that there are several patented processes of anodic cleaning, but they are forced to stand on their own merit, as the basic principles of electrocleaning are found in prior art.

Perhaps the basic law of most importance in superior chromium plate is that there must be a non-porous intermediate plate. The possible exception to such a universal rule is when the foundation metal has the characteristics of the intermediate plate. This is true of pure gold and of nickel. Neither exception is of commercial importance.

With a non-porous foundation metal, nickel forms the ideal intermediate plate. Due to their relative positions in the Volta electro-motive series, iron has little tendency to rust when in contact with nickel. Likewise nickel may be deposited with a fine-grained structure which may be highly colored, thereby serving as a desirable base for chromium, which is faithful in its reproduction of the finish of the underlying metal.

With a slightly porous foundation metal, a light coat of nickel should be followed by a heavy coat of very soft copper. The surface of this copper should be flowed on a polishing wheel in order to close the pores. This should be followed by a second light coat of nickel, which is colored and then chromium-plated.

Although cadmium itself forms a corrosion-resistant plate for porous steel, it is not recommended as an intermediate plate. In order to obtain a pleasing chromium plate, it is desirable to follow the cadmium plate by a nickel plate. Actual weathering conditions show an exceedingly short life for such a plated article. Likewise zinc, either electroplated or hot dipped, has not been found satisfactory for an intermediate plate.

Again it is pointed out that the intermediate plate of nickel or multiple plate of nickel-copper-nickel should be soft and adhesive so that it will not be separated from the foundation metal or from the outside plate, due to the lateral stresses superposed by the chromium.

Since this article deals with the durability of chromium, space permits only reference to plating technique, to show its influence on the permanency of the plate.

Variables in chromium plating are current density, temperature, time of deposition, concentration of chromic acid, percentage of sulphate, percentage of trivalent chromium, and quantity of foreign impurities. These variables are interrelated. In opening a new plant these operating variables should be standardized to their optimum value for the particular article to be plated through the services of a man with comprehensive experience in chromium rather than left to the haphazard trial and error method of a plater.

Once these standards are established, the operator should understand that he is subject to dismissal if he purposely attempts to experiment with these constants. This does not limit the ingenuity of the plater, as his inventive activities may be employed usefully in improving the racking of the articles. Such military exactitude is not dogmatic, but it is necessary in order to obtain reproducible results.

IN ORDER to attain uniformity, automatic equipment should be introduced wherever possible. For example, a constant voltage regulator, regardless of amperage load, is desirable for the motor-generator equipment. Automatic thermostatic temperature control is essential. Mechanical timing should be used for the period of deposit. The plating solution should be circulated and filtered continuously. Automatic equipment is shown in the accompanying illustrations, obtained through the courtesy of *Metal Cleaning & Finishing*.

Ingredients of the plating solution must be maintained at predetermined values by necessary additions as shown by periodic tests. These tests and additions should be made, if possible, by a man not associated with the plating and therefore not responsible to the plating foreman. The length of time between tests and addition of ingredients should be predetermined and adhered to strictly. This period will depend on the ratio of the volume of the solution to the total current used; the drag out of the solution by the plated article; and, to a lesser degree, the drag into the solution of impurities by the articles to be plated.

All metals are electrodeposited in a crystalline formation. With this is associated a tendency to contraction as the metal plate is formed. If a thin sheet of metal is plated on one side only, the sheet will be bent concave in respect to the side plated. With a metal such as copper, which is soft and ductile, this tendency to contract is of little importance. But in the case of chromium deposition, these internal lateral contractile stresses are of prime importance in respect to the durability of the plate.

Their influence may be manifested in two ways: First, if the adhesion is poor between the nickel and the foundation metal, the chromium will lift the nickel; second, if the adhesion is satisfactory, these stresses may cause the formation of fissures in the chromium. These fissures are of various types. They may form lacework designs on the surface of the article, as shown by rust creeping through the fissures if the article is subjected to weathering without being cleaned.

When only a comparatively thin plate is desired, as in ornamental plating, the contractile stresses may be minimized by the selection of proper operating variables. The method of research I have used to study the influence of the operating variables on these stresses is to plate a given thickness of chromium on a thin strip of copper, which may be dissolved by the use of nitric acid. A quantitative measurement of the contractile force may be stated in terms of the radius of curvature to which the chromium curls. The optimum operating conditions are represented by a sheet of chromium which remains flat when freed from the copper. This method of research also gives useful information as to the porosity and the brittleness of the chromium. Contrary to published opinion, chromium may be deposited in a dense non-porous state.

Thus it is shown that the chromium plate itself must be given serious attention in order that it may afford maximum protection. In general, it has been the policy of the plater to put on the thinnest possible coat of chromium. This has been the path of least resistance. The bright range is far greater for a flash of chromium than for a reasonably thick deposit. An exceedingly thin plate has a low contractile force, since this force increases directly with thickness, and therefore there is less tendency to peel.

A certain automobile manufacturer standardizes on 45 sec. for chromium-plating a radiator shell. The average time for chromium-plating all types of articles is approximately 5 min. My experience does not permit me to accept the general consensus of opinion that such a thickness of plate gives maximum durability. Instead it is maintained that operating factors should be so controlled that it is possible to standardize on 15- to 30-min. plates, which are ductile, free from excessive lateral stresses and non porous.

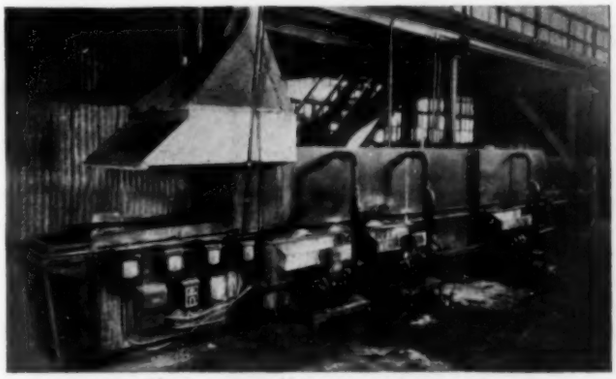
CHROMIUM plate should withstand severe abuse from its user. Instead the typical plate of today requires special nursing. Due to its extreme thinness it possesses no intrinsic hardness, as shown by the fact that it is scratched if cleaned by gritty waste. Each time it becomes wet it must be rubbed dry to prevent the formation of rust underneath. Incidentally this is the reason that a radiator shell seldom rusts in service as compared to other plated parts, such as bumpers, on the same car. The heat from the radiator immediately dries the shell.

Not only is a thin, fissured plate of chromium of short life but this condition is enhanced if the intermediate coat is not of sufficient density to protect the chromium from the iron base. This is because the corrosion of iron actually is accelerated by contact with chromium, due to the formation of electromotive cells.

A thick, non-porous plate of chromium requires little attention. Even if not cleaned for long periods the surface will not be stained. The apparent staining of faulty deposits of chromium is due to the corrosive material in the fissures of the chromium.

It is reasonable to expect a life of five years for chromium trimmings on an automobile and ten years for plumbing fixtures. Since in many cases the manufacturers do not guarantee chromium-plated fixtures as to permanency, the user may be confronted with the problem of a rusted or bare fixture. Due to the brilliancy of chromium, the defect is exceedingly noticeable. The owner, therefore, is forced to decide between buying a new fixture or having the defective part replated.

In general, it may be stated that replating is a source of grief both to the user and to the plating shop. It is far more satisfactory to buy a new door handle than to have the old door handle replated. This economy is illustrated by the fact that a large manufacturer of automobile bumpers has adopted the practice of scrapping a bar rather than attempting to replate it if it does not pass final inspection.



Automatic Unit for Enameling Parts of Plated Article

The use of accelerated life tests to determine the durability of chromium has not been mentioned purposely, because results from such a test are inconclusive, if not misleading. Likewise, visual inspection at the plant will not disclose factors contributing to short life. The durability of chromium can be judged only by its performance under actual service conditions.

Deficiencies in chromium-plated articles are due primarily to the fact that the market developed over night and the product was placed on the market by many companies without any preliminary life tests.

As a group the manufacturers are extremely anxious to market the best possible chromium-plated product. But they are handicapped by lack of authoritative disseminated information on chromium-plating operation. Results of much of the valuable research carried on has been guarded as secret trade information. With few exceptions the published information is fragmentary and often contrary to fact.

It is recommended that the companies already in the chromium-plating field scrutinize their methods and processes thoroughly, thereby bringing their work up to the best possible standards of practice. Likewise, a company considering entering the field should give conscientious consideration to three points: first, design of the article in reference to the peculiarities of chromium deposition; second, engineering plans for the installation of an automatic plating plant; and third, careful training of the operating personnel.

In conclusion, it may be stated that the lack of durability of chromium-plated articles has not been due primarily to poor workmanship or attempted economy but rather to an imperfect understanding of the influence of various factors on the permanency of chrome fixtures.

Aluminous Insulating Materials Resist High Temperatures

By J. BRYTE BARNITT
Research Engineer
Aluminum Co. of America

and R. H. HEILMAN
Senior Industrial Fellow
Mellon Institute of Industrial Research

APPLICATION of commercial heat-insulating materials has attained its greatest impetus during the present century. The increased cost of fuel, the demand for more flexible and exact control of all processes employing heat, and the continued development of new products, have resulted in an extensive search for materials with longer life which will withstand severe conditions and conserve a greater quantity of heat. The most recent development in this search is the production of heat-insulating materials from minerals which consist chiefly of aluminum oxide. These materials have low thermal conductivities and excellent strength and are stable at the higher temperature ranges. Their applications lie in the range from the temperature of boiling water to temperatures as high as insulation is deemed feasible.

In the lower part of this temperature range some of these have been found to be efficient and satisfactory. In the upper part, however, the same chemical compounds which make excellent refractories are used. The difference which distinguishes insulating materials from refractories is one of physical rather than chemical characteristics. All insulation materials owe their insulating properties to entrapped air spaces, air being a very poor conductor of heat. In the vegetable kingdom hollow cells and hollow fibers are quite common, due to the growth habits of the plants, whereas in the mineral kingdom cellular structures are quite rare. In the two best known instances—namely, pumice and diatomite—the air-cell structure of the materials is due to their natural mode of formation. On the other hand, it has been found possible to process certain minerals, thereby producing the proper cell structure to make them suitable for insulating purposes.

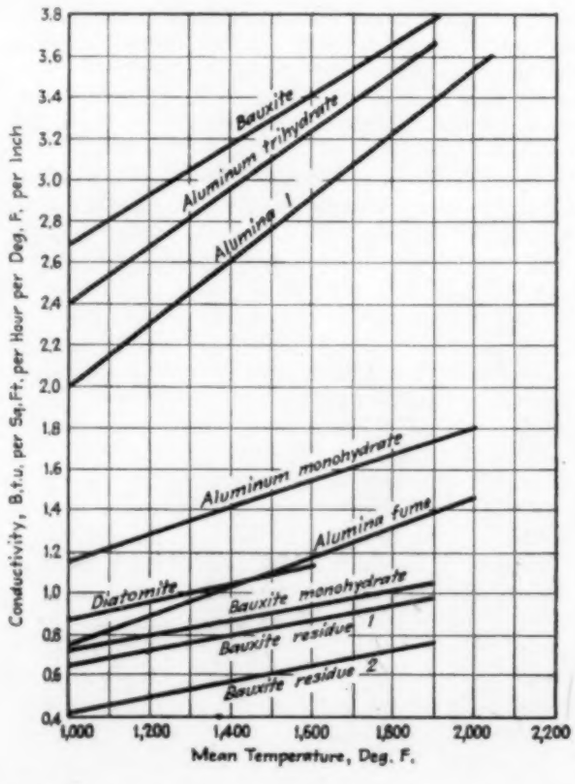
The bulk of refractory materials consists of but three chemical compounds: silica, alumina, and their combinations in the form of clays. Of these, silica and clays have been extensively used in the production of heat-insulating materials, but alumina has had but little application until recently.

Silica came into use first, due to the fact that all over the world there are extensive deposits of diatomite. This is formed by the deposition of the empty husks of elementary marine plants known as *diatomaceae*, species of which grow in both fresh and salt water and which are microscopic in size. The husks are pure silica but in deposition they are sometimes admixed with clay and organic matter. Many of these deposits are quite deep and extensive and the material is naturally well cemented, so that it can be quarried and cut to size and shape for use. When exposed to temperatures approaching 1,600 deg. F., diatomite weakens and shrinks. This is due to the physical transformation from the natural quartz form to tridymite.

In order to obtain an insulating material for use above this temperature the diatomite is disintegrated, carefully purified, and then mixed with a small percentage of lime or clay, after which it is molded and calcined at temperatures above 1,600 deg. F. to convert it to the form which is stable in the higher temperature range. Silica insulating brick made in this manner will withstand temperatures up to 2,500 deg. F. Such bricks in some instances are stronger and more dense than the natural diatomite and in all cases have higher thermal conductivities.

Clay occurs abundantly in nature but is naturally devoid of a suitable cellular structure. Clay insulating bricks are made in several ways, the most common of which is by mixing with finely divided organic matter which is burned out in the processing, thereby giving the proper porous structure, or by aerating with inert gases.

Fig. 1—Thermal Conductivities of Insulating Materials in Powder Form



Presented before the Mineral Industry section of the Engineers' Society of Western Pennsylvania in joint meeting with the A.I.M.E., April 13, 1931, Pittsburgh, Pa.

Prevention of shrinkage and spalling are just as serious problems with bloated clay brick as with the more dense refractory products.

Pure silica has a melting point of 3,110 deg. F. and the higher melting clays soften at 3,090 deg. F., whereas pure alumina has a melting point of 3,720 deg. F. (C. W. Kanolt, Bureau of Standards, Tech. Paper No. 10). The alumina obtained in various methods of extracting it from aluminous ores by the Bayer and the fusion processes is of a very high degree of purity and therefore should resist temperatures up to 3,600 deg. F. and in this respect is superior to siliceous materials. Alumina does not undergo crystalline transformations, with consequent shrinkage or weakening, until the temperature of

Table I—Thermal Conductivities of Powdered Materials Investigated

Material	Density Lb. per Cu.Ft.	Conductivity B.t.u./Sq.Ft./Hr./ Deg. F./In *1,000 Deg. F.	Conductivity B.t.u./Sq.Ft./Hr./ Deg. F./In *1,600 Deg. F.
Diatomite	22	0.864	1.134
Bauxite	92	2.680	3.410
Bauxite Monohydrate	22	0.713	0.935
Alumina—1	68	2.010	2.820
Alumina—2	150	3.710	5.180
Alumina Fume	40	0.750	1.175
Aluminum Monohydrate	24	1.160	1.540
Aluminum Trihydrate	80	2.400	3.240
Bauxite Residue—1	63	0.650	0.870
Bauxite Residue—2	50	0.420	0.650

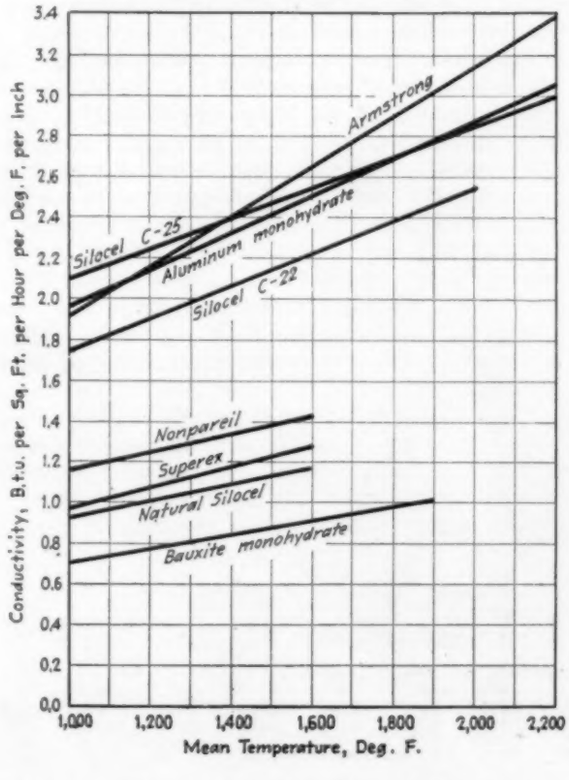
*Mean temperatures.

recrystallization to corundum is reached and in this respect is superior to siliceous materials. This is considerably higher than the temperatures insulating materials are required to withstand.

All of the commercial grades of bauxite occur in dense form and the pure alumina which is extracted from them is also obtained in dense form, so that these materials, although excellent as refractories, have thermal conductivities too high for consideration as insulators.

Our search for possible sources of alumina containing raw materials which might be of value as bases for the manufacture of heat insulation has covered a large variety

Fig. 2—Thermal Conductivities of Insulating Materials in Brick and Block Form



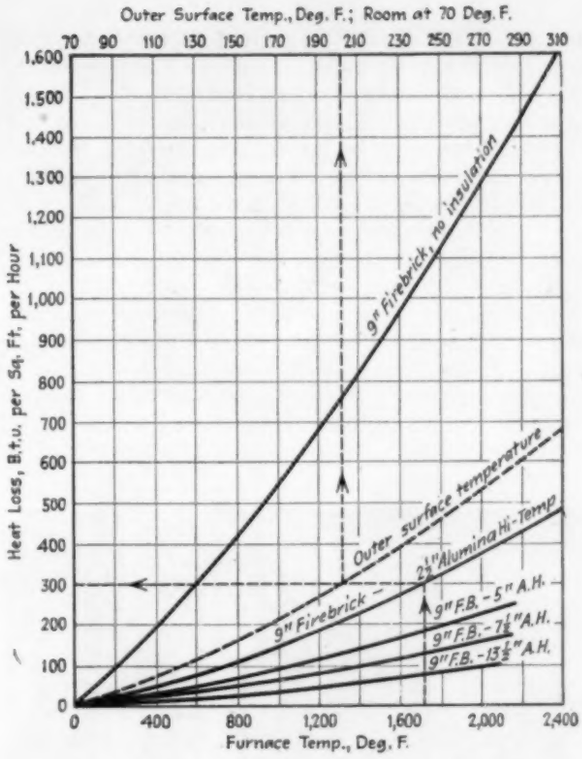

Outer Surface Temp., Deg. F.; Room at 70 Deg. F.
Heat Loss, B.t.u. per Sq. Ft. per Hour
Furnace Temp., Deg. F.
9" Firebrick, no insulation
Outer surface temperature
2½" Alumina Hi-Temp
9" Firebrick
9" F.B. - 5" A.H.
9" F.B. - 7½" A.H.
9" F.B. - 13½" A.H.

Fig. 3—Heat Losses Through Furnace Walls, Insulated and Uninsulated

of aluminous materials. The following includes a number of the more promising materials investigated: (1) bauxite; (2) monohydrated bauxite; (3) alumina (Bayer process); (4) alumina (fusion process); (5) alumina fume; (6) aluminum monohydrate; (7) aluminum trihydrate; (8) bauxite residue; and (9) bauxite residue, floated.

These materials were compared with a commercial grade of diatomaceous earth powder. Comparative thermal conductivities of the materials investigated are shown in Tables I and illustrated graphically in Fig. 1.

Diatomite occurs naturally, widely distributed in various states of purity. In addition to its use as a heat insulator, it is extensively employed as a polishing agent under the name "tripoli." It is also used as a filtering medium, plasticizer in cements, and as an inert filler in many industries.

Bauxite is the result of the weathering of felspathic rocks in semi-tropical or tropical climates. In bauxites the aluminum exists as a hydrate. It finds its most extensive use as a raw material for the preparation of alumina and, in turn for metallic aluminum and its alloys. The alumina, alundum, and corundum industries employ it in the preparation of refractories and abrasives and it is the principal source of raw material for the alum industry.

Monohydrated bauxite is produced by the chemical treatment of raw bauxite. This material in powder form is highly porous, exceedingly fine, and of very low apparent density. These qualities recommend it as an excellent material for heat insulation.

Alumina produced by the Bayer process is a fine granular material, its grain size depending on the method of precipitation. Its principal use is in the production of metallic aluminum, although quantities are used for refractories and abrasives. It can be used as an insulating material for very-high-temperature furnaces, as it will

withstand 3,600 deg. F.; but it does not have as low thermal conductivity as many of the commercial insulating materials used at lower temperatures.

Alumina produced by the fusion process is formed in small hollow pills by the action of an air blast on molten alumina slag. Its primary use is for the production of metallic aluminum. Formed into brick with suitable binder it makes an excellent refractory. Its thermal conductivity is lower than most refractories but too high to be classed as an insulating material.

Alumina fume is a very finely divided mixture of alumina and silica which is a byproduct of the fusion process. It can be used as an insulating powder.

Aluminum monohydrate is produced from aluminum trihydrate by the same chemical process by which bauxite is converted to the monohydrated form. Being of high

Regenerators in the Glass Industry Covered With the Aluminum Oxide Insulation

purity and low apparent density, it will withstand very high temperatures and investigation has shown it to be worthy of consideration as a raw material source for high-temperature insulation.

Aluminum trihydrate is an intermediate product which is obtained in the manufacture of alumina by the Bayer process. Its chief use is in the production of alum. In special form and activated condition this material has extensive application as a desiccant and adsorbent. It is particularly useful in the adsorption of moisture and impurities from air and commercial gases and can be reactivated for continued use.

Bauxite residue is the waste product which results from the extraction of pure aluminous material from bauxite. After having been water-floated and chemically treated, it has been found useful as an inert filler, particularly in the rubber industry. It is also employed as a raw material in portland cement manufacture.

From an examination of the properties of the materials investigated as indicated in Table I, it is evident that only three of the more promising aluminous materials

Table II—Thermal Characteristics of Molded Insulation Investigated

Insulation	Recommended Temperature, Deg. F.	Apparent Density, Lb. per Cu.Ft.	Conductivity—B.t.u./Sq.Ft./Hr./Deg. F./In. 1,000 Deg. F.*	Conductivity—B.t.u./Sq.Ft./Hr./Deg. F./In. 1,600 Deg. F.*	Per Cent Linear Shrinkage Recommended Temperature
Superex Block	1600	24	0.966	1.270	1.7
Natural Sil-O-Cel Brick	1600	29	0.925	1.170	1.0
Sil-O-Cel C-22 Brick	2000	36	1.750	2.220	0.0
Sil-O-Cel C-25 Brick	2500	44	2.100	2.540	2.6
Nonpareil Brick	1600	30	1.160	1.420	1.3
Armstrong Brick	2500	36	1.920	2.650	5.0
Bauxite Monohydrate Block	1900	27	0.710	0.910	1.0
Aluminum Monohydrate Brick	2500	45	1.950†	2.500†	1.7

*Mean temperatures. †Experimental.

under investigation show evidence of possible use as heat insulators. These are monohydrated bauxite, aluminum monohydrate, and floated bauxite residue. Of these three, one of the most surprising developments was that floated bauxite residue should have such a low conductivity and still be of such high density in comparison with the monohydrated products and with diatomite. Unfortunately, the high density of this material tends to preclude its use as insulating powder except in districts adjacent to its source. This gives the advantage on a weight basis to monohydrated bauxite and aluminum monohydrate. In so far as actual conductivity is concerned, aluminum monohydrate is somewhat higher than monohydrated bauxite. Obviously, aluminum monohydrate will have application in the higher temperature field on account of its greater purity and higher melting point, but, due to the fact that it is made from a refined aluminous material, it is more expensive.

Further investigational work was then undertaken to establish the possible application of these materials to the fabrication of a molded type of insulation. Experiments with floated bauxite residue demonstrated that this material, when molded into block form, showed marked shrinkage on drying which precluded its use in this field. However, the fact should not be overlooked that bauxite residue is an excellent insulating powder.

Investigation of the properties of aluminum monohydrate revealed the practicability of its use as a base for insulating bricks for temperatures as high as 2,600 deg. F. The use of this aluminous material as a base is considerably enhanced by its high state of purity, which results in raising its fusion point to approximately that of pure alumina. Our tests have shown that insulating bricks employing aluminum monohydrate as the principal ingredient, when molded and fired, possess excellent insulating and refractory qualities.

After the properties and field of usefulness of both bauxite residue and aluminum monohydrate were definitely established as heat insulators, the next problem was the consideration of possible applications of monohydrated bauxite.

From the data in the tables previously cited, it is quite apparent that monohydrated bauxite in powder form is a superior insulating material. It compares favorably in density, stability, and insulating value with any of the present commercial materials. An investigation was then

Table III—Maximum Furnace Temperature for Various Thicknesses of Monohydrated Bauxite Block

(Results in Deg. F.)

Thickness of Firebrick, Inches	Thickness of Monohydrated Bauxite Block, Inches												
	2	2.5	3	3.5	4	5	6	7	8	9	10	12.5	13.5
9	2,510	2,400	2,350	2,300	2,250	2,160	2,130	2,090	2,070	2,060	2,040	2,010	2,000
13.5	2,800	2,575	2,520	2,460	2,400	2,280	2,250	2,220	2,190	2,170	2,140	2,070	2,040
18	3,020	2,800	2,720	2,640	2,560	2,400	2,340	2,280	2,240	2,210	2,180	2,120	2,090
22.5	3,250	3,050	2,940	2,840	2,730	2,520	2,450	2,380	2,330	2,300	2,260	2,180	2,150

undertaken to develop the application of this aluminous material in the form of a commercial heat-insulating block. Extensive experiments were conducted to determine the proper ratio of the various ingredients which would result in a molded product of high insulating value, low shrinkage, and satisfactory strength when exposed to high temperatures.

The results of these experiments demonstrated that insulating blocks of excellent quality could be made in the laboratory. Quantities of the molded block were then manufactured and tested for their various properties and compared with other commercial grades of insulating material having similar application. From these tests the information indicated in Table II was obtained. These results are shown graphically in Fig. 2.

Data shown in Table II for monohydrated bauxite block were obtained from block previously heated at temperatures of 1,000 to 1,050 deg. F. The thermal conductivity of similar blocks dried at low temperature may be increased as much as 30 per cent.

An inspection of the data in Table II reveals two very important facts: namely, that monohydrated bauxite blocks have the lowest conductivity value of the materials investigated, and that it maintains its heat resistance without breakdown up to a temperature of 1,900 deg. F. This is of paramount commercial significance, as it is a well-known fact that there are many instances where the operating temperature of equipment is such that the uncalcined diatomaceous-earth insulating materials do not have sufficient heat resistance (recommended temperature, 1,600 deg. F.) to enable them to be employed, and it is therefore necessary to use the calcined or higher temperature brick (recommended temperature, 2,000-2,500 deg. F.).

From Table II it will be seen that the insulating value of the calcined diatomaceous bricks is only one-half to one-third that of the uncalcined ones, or that of monohydrated bauxite blocks. It is obvious that an upward extension of the temperature range of from 300 to 400 deg. F. over that of the uncalcined material, coincident with better insulating value, will result in great economy; lower heat losses; lower first cost, on account of reduced thickness of insulation required; and also less weight of material, which is of special importance, particularly in marine work.

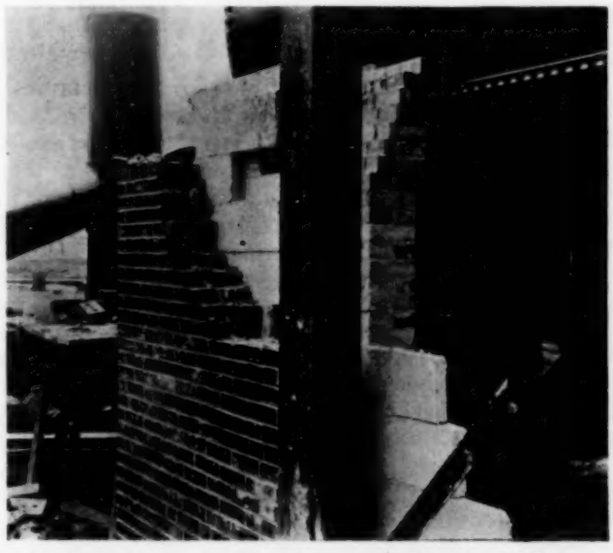
Another very important feature is the fact that this new material can be molded into large blocks, which greatly reduces the number of joints encountered when using the standard brick types of insulation. The large size of the blocks also results in considerably lower installation cost.

Heat Insulating Materials, Consisting Chiefly of Aluminum Oxide, Have Low Thermal Conductivities and Excellent Strength

Table III gives the optimum furnace temperatures which can be used when employing various thicknesses of monohydrated bauxite blocks on different thicknesses of refractory brick walls. As an example of the use of Table III, assume that a furnace built up of a 13½-in. firebrick wall is operating at a temperature of 2,400 deg. F. From Table III it appears that in order not to exceed a temperature of 1,900 deg. F. on the hot side of the monohydrated bauxite block, the insulation thickness should not exceed 4 in. Similarly, with a wall thickness of 18 in. of firebrick, the insulation thickness should not exceed 5 in.

In Fig. 3 are shown calculated heat losses, and outer surface temperatures for a 9-in. firebrick wall uninsulated, and insulated with increasing thicknesses of monohydrated bauxite blocks.

An experimental plant has been erected at East St. Louis, Ill., to manufacture monohydrated bauxite blocks on a commercial scale. Large quantities of these insulating blocks 9x36 in. and 12x36 in., of various thicknesses, have been fabricated and installed on several types of industrial furnace and heating equipment. Results to date have been highly satisfactory and users of this new type of heat insulation have accorded it a very enthusiastic reception. As the composition of these blocks is mainly of an aluminous material, the name "Alumino" has been given to this recently developed type of insulating product.



Insulating Creosoting Equipment With Alumino Hi-Temp

Agricultural Aspects of Sulphur And Sulphur Compounds

By J. G. LIPMAN and H. C. McLEAN
Dean and Associate Professor of Soils, respectively of Rutgers University

SULPHUR is one of the essential plant nutrients. The soil and the atmosphere supply the combined sulphur required by crops, but this supply is not always adequate. The need of some crops for sulphur is more pronounced than that of others. To this group belong legumes like alfalfa and soybeans, and *cruciferae* like cabbage and rape. In some soil regions there seems to be a notable deficiency of sulphur, for carriers of this constituent, whether they be sulphates, sulphides, ground brimstone, or organic sulphur compounds, almost invariably increase crop yields when applied in proper amounts and at the proper time. Rather extensive soil areas of this character have been studied in Idaho (McDole, G. P., and Christ, J. H., 1925, "Farming Practices for the Cut-Over Lands of Northern Idaho," Idaho Agri. Exp. Sta. Bul. 136), Oregon (Powers, W. L., 1923, "Sulphur in Relation to Soil Fertility," Oregon Agri. Exp. Sta. Bul. 199), and Washington (St. John, J. L., and Neller, J. R., 1924, "Gypsum and Sulphur as Fertilizers for Legumes," Washington Agri. Exp. Sta. Popular Bul. 128). Soil regions giving a more or less marked response to sulphur treatment have been found elsewhere in the United States and in other parts of the world.

Aside from its functioning as a plant nutrient, sulphur may be used also as a soil ameliorant. For this purpose, however, elementary sulphur, in a finely divided condition, rather than combined sulphur, is the desirable material. In soils with a pH above 7, the crops may not be able to obtain a sufficient supply of soluble iron and they then become chlorotic. Applications of sulphur and the biological transformation of the latter into sulphuric acid are utilized as a corrective of this condition. Similarly, some plants prefer a soil medium rather more acid than the average. Accordingly, ground brimstone, or physiologically acid fertilizers like ammonium sulphate, are successfully employed for increasing the hydrogen-ion concentration of soils in which rhododendrons, azaleas, blueberries, and creeping bent grasses are to be grown.

There are important agricultural crops whose yield is seriously depressed by fungous diseases. Scab of potatoes (Martin, W. H., "The Relation of Sulphur to Soil Acidity and to the Control of Potato Scab," Soil Science, Vol. IX, No. 6, 1920) and beets, and scurf and soil-rot of sweet potatoes (Poole, R. F., 1922, "Recent Investigations on the Control of Three Important Field Diseases of Sweet Potatoes," New Jersey Agr. Exp. Sta. Bul. 365) are the best known examples of such diseases. It happens that there is a considerable degree of tolerance in these crops to soil activity. Hence with the aid of sulphur the pH of the soil may be lowered to 4.5-5.0 without markedly depressing the crop yield, but controlling, at the same time, the activities of the particular fungi.

In arid and semi-arid regions soil leaching is limited, or, at best, less thorough than it is in humid regions. The soluble salts scattered through the mass of soil are readily dissolved by irrigation water, brought to the surface by capillarity, and concentrated in the top layer. This accumulation of soluble salts is known as "alkali." When the soil silicate complexes are rich in sodium a so-called "black-alkali" condition develops. The soil colloids are then dispersed, the soil itself becomes more or less impervious to irrigation water and the washing out of the excess of soluble salts becomes practically impossible. It was suggested by the writer, about 15 years ago, that such black alkali land could be reclaimed by the use of sulphur. Since that time it has been demonstrated that sulphur may be used successfully for this purpose (Kelley, W. P., and Thomas, E. E., 1928, "Reclamation of the Fresno Type of Black-Alkali Soil," Calif. Agr. Exp. Sta. Bul. 455; Powers, W. L., 1923, "Sulphur in Relation to Soil Fertility," Oregon Agri. Exp. Sta. Bul. 199).

Table I—Sulphur Content of Soils
(In surface soils 6 in. to 7 in.)

Region	Range in Pounds per Acre	Region	Range in Pounds per Acre
United States	160— 2,600	Earth's Crust	2,200
Illinois	600— 1,000	Wisconsin	400— 1,200
Iowa	719— 938	Kentucky	360— 1,000
Ohio	412— 800	Eastern Washington	246— 712
Oregon	140— 1,100	Indiana	480
Maryland	160— 828	Utah	252— 1,764

Considerable quantities of sulphur are used in the preparation of sprays and dusts for the control of insects and fungi injurious to economic plants. No accurate information as to the amounts of sulphur used for this purpose is at present available. In commercial apple orchards quantities of sulphur up to 320 lb. per acre are frequently employed in a single season. More or less substantial quantities of sulphur in the form of dusts or sprays are used also by growers of vegetables, grapes, and roses. Altogether, therefore, sulphur finds a place in agriculture as a plant nutrient, as a soil ameliorant, as a means of correcting the reaction of the soil, and as a control measure against certain insects and fungi. But the major question involved in the agricultural uses of sulphur centers about the value and employment of this element as a plant nutrient.

As was already noted above, the sulphur requirements of crops are met by supplies from the soil and the atmosphere. Analytical data at hand, representing many thousands of analyses, show that the sulphur content of soils usually varies between 400 and 1,000 lb. per acre

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to a depth of 6 to 7 in. The range of sulphur content in soils from different localities in the United States is given in Table I.

Considered as a source of this particular nutrient most soils would be depleted in less than 100 years, often in less than 50 years. This is indicated by the quantities of sulphur removed in average crops, as recorded in Table II.

Aside from removal by crops, the sulphur content of soils is constantly being diminished by leaching and drainage. The losses due to this cause are extremely variable, since the nature and size of the crop, and more particularly the amount and distribution of rainfall, must directly affect the leaching and drainage of soils. The data given in Table III are a rather reliable index of sulphur losses by drainage as they occur in different agricultural regions.

Table II—Pounds of Sulphur and Phosphorus Removed Per Acre*

	Dry Weight, Pounds	Sulphur, Pounds	Phosphorus, Pounds
Wheat, grain, 30 bushels	1,530	2.6	6.2
Wheat, straw	2,653	3.7	3.0
Total crop	4,183	6.3	9.2
Corn, grain, 30 bushels	1,500	2.6	4.4
Corn, stalks	1,877	2.2	3.5
Total crop	3,377	4.8	7.9
Beans, grain, 30 bushels	1,613	3.8	10.0
Beans, straw	1,838	2.0	2.8
Total crop	3,451	5.8	12.8
Turnips, roots	3,126	23.1	9.8
Turnips, tops	1,531	13.8	4.7
Total crop	4,657	36.9	14.5
Potatoes	3,360	4.6	9.4
Alfalfa hay	9,000	26.0	17.4
Cabbage	4,800	39.2	26.6

*Hart, E. B., and Peterson, W. H., 1911, "The Sulphur Requirements of Farm Crops in Relation to the Soil and Air Supply." Wis. Agr. Exp. Sta. Res. Bul. 14.

The four locations named in Table III are widely scattered. At Rothamsted, England, the annual rainfall is equivalent to about 30 in. At Knoxville, Tenn., and Ithaca, N. Y., it is substantially larger, and at Corvallis, Ore., it is equivalent to 42.32 in. The assumption that the annual loss, on account of drainage is 30 lb. per acre in humid regions, would represent an underestimate, rather than an overestimate.

Losses of sulphur chargeable to cropping and drainage are partly offset by the varying quantities of combined sulphur brought down by rain and other atmospheric precipitation. In localities where large quantities of coal and petroleum are used as fuel, much sulphur is added to the atmosphere. The quantity of this constituent in precipitation is thus materially increased. Reference to analytical data on this point, collected at different stations, will be found in Table IV.

Despite the nearness of Rothamsted to London (less than 30 miles), atmospheric precipitation at this point contributes less than 10 lb. of sulphur per acre annually. On the other hand, Knoxville and other stations in Tennessee show a maximum addition of 232 lb. per acre. This is an abnormal quantity. The quantities reported for Wisconsin and Washington also are small. A careful analysis of all of the available data leads to the conclusion that 15 lb. per acre per annum would represent a fair average; if anything, an over- rather than an underestimate.

On the credit side there should be included the sulphur furnished by different fertilizers. The most important among these are superphosphate and base goods. The next most important fertilizer material is ammonium sulphate. Certain other additions are derived from imported potash salts, land plaster, hair and wool waste, and offal from slaughter houses and fish-canning establishments. These contributions, as well as those supplied by cottonseed, soybean, and other vegetable cakes, are relatively unimportant. The quantities contributed by several of the fertilizer materials are given in Table V. The data given in this tabulation are averages for the years 1927-1929. They show that superphosphate and base goods enriched the soils of the fertilizer-using areas of the United States with 446,500 tons of sulphur. Ammonium sulphate furnished 176,000 tons and the potash salts about 30,000 tons. The total in the several materials was 653,000 tons, a very substantial amount when the various sources of gain and loss are considered. For the time being no account is taken of the gains due to the applications of other materials.

In studying the income and outgo of sulphur in the soils of the United States consideration must obviously be given to animal manures as an important factor. The quantity of manure produced in 1927 by all domesticated animals and birds was, in round figures, 1,300,000,000 tons, with a sulphur content of probably between 600,000 and 700,000 tons. It should be remembered, of course, that most of this manure was deposited on the vast area of substantially more than a billion acres of range and meadow land. It is doubtful whether the 333,000,000 acres of crop land used as a basis of calculation in Table VI received an addition of more than 100,000 tons of sulphur, for a portion of it in stored manure is lost both by fermentation and leaching. It is well to remember, likewise, that in the burning of cornstalks, hay, straw, cotton stalks, and other vegetable materials some of the sulphur contained in them escapes into the air.

In summarizing the debit and credit items in our national sulphur account we may consider the losses due to removal in crops and in drainage waters and the gains due to additions in atmospheric precipitation and applications of commercial fertilizers. The data in question are given in Table VI.

Roughly speaking, the sulphur removed by cultivated crops and grasses is compensated for by applications of animal manures and commercial fertilizers. The major item in the situation is the loss of sulphur due to drainage. The annual loss of about 5,000,000 tons of sulphur from our land in crops is offset to the extent of about 50 per cent by additions from atmospheric sources. We are thus faced with an apparent annual deficit of 2,500,000 tons of sulphur, a deficit that, from the standpoint

Table III—Annual Removal of Sulphur in Drainage Water

Location	Range, Pounds of Sulphur per Acre	Location	Range, Pounds of Sulphur per Acre
Oregon	40 to 45	Rothamsted	20 to 80
New York	35 to 47	Tennessee	13 to 64

Table IV—Pounds of Sulphur per Acre Supplied Annually by Rainfall

Location	Range	Location	Range
Rothamsted	7	Washington	5.57
Wisconsin	6.8 to 7.2	Iowa	14.89
Tennessee	12.7 to 232	Kentucky	36.00
Utah	6.4 to 32.7	Texas	6.56 to 15.46
Virginia	17	New York	24.6 to 35.9

Table V—Sulphur Supplied to Soils of United States in Fertilizers

Fertilizer	Tons of Sulphur
Superphosphate and base goods	446,500
Potassium sulphate	14,500
Miscellaneous potash salts	16,000
Ammonium sulphate	176,000
Total	653,000

of national economy, should receive the most thoughtful study. There was a time when large quantities of land plaster were used in American agriculture. But the practice of plastering the land, so common in colonial and early post-revolutionary years, fell into disrepute as the introduction and widening use of chemical fertilizers brought new sources of sulphur for replenishing this necessity.

At this time new factors are making themselves felt in our national economy. Phosphoric acid is being used in increasing quantities for the neutralization of byproduct and synthetic ammonia. Synthetic sodium and ammonium nitrates, the expanding production of urea, and the larger use of anhydrous ammonia in the manufacture of fertilizers are other factors of importance. Under the circumstances, there is the tendency toward a reduced use of sulphuric acid in the fertilizer industry. It is proper to ask, therefore, whether the more or less far reaching changes coming into our fertilizer industry, coupled with the crop intensification program which must become a part of our new agriculture, may not justify a careful study of our plant-food resources. In a study of this sort the rôle of sulphur as an essential plant nutrient should be considered, particularly from the standpoints of soil management, land utilization, and national economy.

Table VI—Agricultural Sulphur Balances in the United States

	Removals, Short Tons	Additions, Short Tons
Cultivated crops*	711,400	.....
Drainage	4,998,000	.....
Precipitation	.....	2,499,000
Fertilizers	.....	653,000
Total	5,709,400	3,152,000
Total deficit	2,557,400 short tons	

*Average for the years 1927 to 1929; taken from International Yearbooks of Agricultural Statistics.

▼ ▼ ▼

Hard and Soft Rubber For Pickling Tanks

By H. E. FRITZ

The B. F. Goodrich Rubber Co.
Akron, Ohio

IN THE steel industry, where sulphuric, muriatic, nitric, or hydrofluoric acid may be used as the pickling or cleaning agent, the subject of tanks or vats for these corrosives has always been one of importance to the engineers or superintendents in charge of such operations. Practically every type of construction material has been used or experimented with at some time or other, but over a period of years nothing has been found for pickling containers which could be considered entirely satisfactory.

The following discussion refers chiefly to the use of sulphuric acid. Until recently, rubber-lined pickling tanks had been considered unsatisfactory for service of this nature, for the following reasons: (1) Soft rubber linings are subject to physical damage, as a result of heavy falling objects or gouging action; (2) the temperatures usually involved are above the range considered satisfactory for prolonged service in soft rubber; (3) extreme temperature changes limit the use of hard rubber. Attempts have been made to overcome some of these difficulties through special rubber compounds such as semi-hard rubber and combinations of hard and soft rubber; however, this line of attack has been only partially successful, and to date rubber linings alone cannot be considered universally satisfactory for pickling service.

After exhaustive studies in rubber compounding without approximating a satisfactory solution to the problem, Goodrich engineers attacked the problem, and the results hereinafter set forth are both sound and convincing evidence that combinations of hard and soft rubber and other materials are the ultimate solution to the perplexing problem of containers for pickling operations.

Rubber linings have the inherent disadvantage of having short life at elevated temperatures, and if long life is to be expected, temperatures in excess of 150 deg. F. should not be allowed. On the other hand, sulphuric acid concentration in excess of 50 per cent cannot be considered.

Rubber linings, when punctured, can be easily repaired and the rubber, being vulcanized intimately to the surface of the wood or steel, prevents spreading of acid behind lining. The defect is discovered in steel quickly, due to a small hole which would be corroded through the tank at the point of injury. And since there can be no loss of acid except by splashing, the floor remains intact.

In an effort to broaden the range of usefulness of rubber linings in pickling vessels, combinations of the best features of the other constructions were combined with rubber into units designed for long and useful life.

Underlying the success of certain rubber-lined products is the Vulcalock process. This is a method of vulcanization whereby soft elastic rubber can be attached directly to the surface of metals with an adhesion exceeding 500 lb. per sq.in., practically an integral union. This process accomplishes what rubber men attempted for 50 years, without the use of a hard-rubber base, thus eliminating danger of cracking and separation. This process does not depend upon an adhesive but "locks" the rubber into the "pores" of the metal base, so that the union is as permanent as the rubber itself. The stability of metal can now be combined with the corrosion- and abrasion-resisting properties of flexible rubber.

A brief discussion of rubber compounds and constructions is in order at this point, in order to clarify some misunderstandings. Rubber may vary in its density or hardness over a scale beginning with a soft resilient product, such as rubber bands, up to a bone-hard and brittle product, such as a rubber comb or battery container. During this progression of physical states, a number of interesting and important changes take place. For example, the soft rubber band may have up to 600 per cent elongation, be resilient, and have a tensile strength of 4,000 lb. per sq.in. and be resistant to abrasion, whereas the hard rubber would have practically no elongation, be fragile, have a tensile strength of 15,000 lb. per sq.in., be utterly worthless as regards life in abrasive service and have a coefficient of expansion seven to nine times that of steel. As the temperature is increased this hard-rubber material tends to become more plastic, but as the temperatures are lowered it becomes glasslike in its nature; hence, extreme changes of temperature taking place in a large vessel usually produce disastrous results in the nature of cracks developing in the rubber. Hard rubber is more resistant to acids at higher temperatures

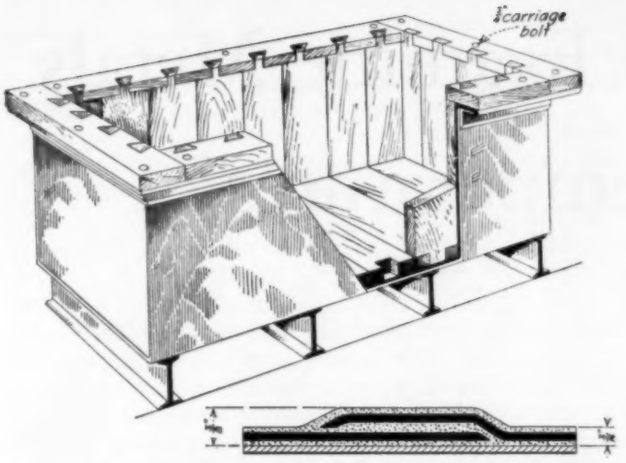


Fig. 1—Wood-Sheathed Rubber-Lined Steel Tanks. In the Triflex Expansion Joint, Hard Rubber Layers Are Not Joined Together; the Soft Rubber Layers Allow for Expansion and Contraction

and also is more resistant to the gouging action of sharp objects than soft rubber; therefore, in some cases it has more desirable properties than soft rubber. On the other hand, soft rubber, being resilient, accommodates itself to conditions of expansion and contraction without damage.

Hard rubber is very resistant to ordinary mineral or vegetable oils; whereas soft rubber is unsatisfactory. In practically all pickling operations small quantities of oil are encountered at the surface of the pickling acid and there is an increasing tendency to make use of the newer organic inhibitors, which have practically the same effect on rubber as oil; hence, it is necessary to use hard rubber in some form or other for this service.

Use has been made of the advantages of both types of rubber, also turning what seem to be disadvantages of each into useful and practical applications by the combination in Triflex construction. This is a combination of soft and hard rubber plies arranged so that the hard-rubber plies are not united but overlap each other, thus offering the protection against physical damage of a hard rubber layer and arranged so that all lap seams form expansion joints. These joints absorb the expansion and contraction of hard rubber, and eliminate buckling and cracking. The hard-rubber layer also offers the advantage of a more resistant material so cushioned as to render it serviceable under conditions of vibration, impact, and strain.

A wood or steel rubber-lined pickling tank using construction of this type with a 2 in. thick wood-protective sheathing is illustrated in Fig. 1. The sole purpose of this sheathing is to prevent physical damage to the rubber. The construction cannot be offered for service in excess of 150 deg. F. The timber on top of flanges is held in place with bolts. Note that the sheathing is free from nails or metal parts except the bolts.

If there is a rubber-lined steel-pickling tank with an acidproof brick and cement lining, and if the brick is laid up in a single course in such a manner that the brickwork is 4 in. thick over the entire bottom and sides and made practically tight, the temperature drop as shown in Fig. 2 may be expected. Acid solutions up to 212 deg. F. can be successfully handled, provided proper air circulation can be maintained around the tank. The brickwork can be laid in place by a brick mason, as there are no irregularities to be encountered. The brick lining affords excellent protection against physical damage to the rubber lining. Temperatures in excess of 212 deg. F. can be handled if a proportionate additional thickness of brick is used. The holes shown in the flanges at the top of the tank are rubber lined and are for the purpose of fastening in place the protective timbers which are to be bolted.

Construction of this type is exceptionally heavy and must be adequately supported to prevent sagging of the tank bottom. It is recommended that the tank be placed on metal, wood, or acid-brick supports, as represented in the illustration. This construction elevates the tank so that air may freely circulate over the sides and bottom of the tank and thus dissipates the heat as fast as it radiates to the atmosphere. This type of tank should never be lagged in any manner or placed directly on a solid foundation.

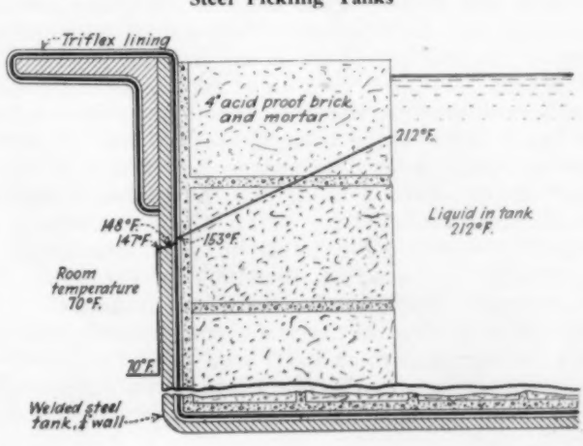
This rubber construction can be applied in the field at the customer's plant and vulcanized in place, provided light steam pressures can be used. Rubber lining can be used for any temperature condition only when protective sheathing of wood or brick is used to prevent damage to the lining.

In laying up brick or wood sheathing care should be exercised that the linings are not damaged or gouged by the workmen in the tanks. Felt or rubber shoes should be worn by the workman. The rubber lining is tough but it can be damaged by rough treatment; therefore tanks should be carefully cleaned out by sweeping and a clean smooth board should be laid on the bottom for workmen to pass over. Nails or pieces of brick or hard material must not be allowed to get under the sheathing. In laying up brick sheathing it is best to lay the bottom in first; then follow with the sides. The protecting timbers over the flanges are important, but in case of brick sheathing if it is desired to replace the timber by brick, this construction will also be satisfactory.

Outlets in rubber-lined steel-pickling tanks are not generally satisfactory and if used precautions should be taken against excessive temperature and physical damage. The safest way to empty pickling tanks is to siphon the acid out over the top of the tank.

In general a high-grade wood-pickling container is slightly higher in initial expense than a rubber-lined steel container. Where temperatures are below 160 deg. F. and a wood-protective sheathing is used, the costs of the two types erected and ready for service are practically the same. In case of rubber-lined steel with brick sheathing the cost will be slightly higher than wood construction but a comparatively longer life can be expected.

Fig. 2—Temperature Gradient in Rubber-Lined Steel Pickling Tanks



Chicago Sessions Examine Metals At High Temperatures

EDITORIAL STAFF REPORT

A WEEK of sultry weather failed to extinguish to any very marked degree the enthusiasm of the more than a thousand members and guests of the American Society for Testing Materials who assembled for the thirty-fourth annual meeting of that organization in Chicago during the week of June 22. A principal feature of the week was a symposium on the effect of temperatures on metals, comprising 27 papers and an extensive bibliography, which was presented under the joint sponsorship of the A.S.T.M. and the American Society of Mechanical Engineers. This carried on and brought up to date work which was initiated by the two organizations, through a joint research committee, in an earlier symposium held in Cleveland in May, 1924. Other sessions presented papers and committee reports on metals, both ferrous and non-ferrous; building materials, paving and waterproofing materials, coal, timber, paints, petroleum products, and electrical insulating materials. Space permits only a brief treatment of the symposium here.

The method of conducting the symposium was very effective. The task of presenting a rapid résumé was assigned to two members of the symposium committee who divided the papers on the basis of angle of attack. One group treated the metallurgical requirements at high and low temperatures of a number of industries, essentially from the user's standpoint. The second group discussed the properties of available metals at high and low temperatures. Abstracting of the first group was handled by L. W. Spring, of the Crane Co., Chicago; and of the second group, by H. J. French, the International Nickel Co., New York City. As a result of this method of presentation, the greater part of each of the two four-hour sessions was available for discussion.

A GROUP of three papers interested chiefly the power-plant industry. Two of them pointed to a number of facts, however, that seem to be of both present and future significance in the generation and handling of high-pressure, high-temperature process steam. In the first of these, H. J. Kerr, The Babcock & Wilcox Co., New York City, wrote concerning boiler and superheater requirements. For high-pressure drums, he called for a tensile strength not less than 100,000 lb. per sq.in. and a ductility approaching that of 0.30-per-cent carbon steel. For high-pressure tubes exposed to radiant heat he called for metals which would creep not over 1 per cent per 100,000 hr. at a temperature of 1,000 deg. and a stress of 10,000 lb. per sq.in. For superheater tubes his specification demanded creep resistance equal to that given above, with the variation that the temperature be 1,300 deg.

In commenting on creep in his paper on high-temperature steam piping, F. W. Martin, of Sargent & Lundy, Inc., Chicago, remarked that this factor applies in piping subjected to even temperatures, only so far as it may cause a reduction in thickness of the pipe wall to the point of failure. Practical considerations make the permissible creep somewhat less than is consistent with safety and a working range of 2 to 3 per cent per 200,000 hr. probably should be chosen, not only for pipe but for valves and fittings as well.

In an interesting discussion of the metallurgical needs of the oil industry, E. S. Dixon, of the Texas Co., Port Arthur, Tex., quoted statements made in the replies he received from an extensive canvass of refiners and manufacturers. It appears that maximum long-time oil temperatures range from 850 to 1,100 deg. F., and maximum short-time temperatures from 1,350 to 1,500 deg. In general, high thermal conductivity as a criterion seems to be a point of contention. If it is of great importance, it is because of the desirability of limiting thermal stresses rather than because of the very slight improvement in heating that would result. Coefficient of expansion is again a debatable requirement, because of the variety of materials available for use with any metal or alloy. A fatigue resistance equal to steel is desirable, but evidently not of primary importance. Creep requirements of various refiners differed considerably. One stated that he designed for a creep of about 1 per cent per year for pressure vessels, allowing also for corrosion.

ON THE subject of fabricating, opinion was divided. Weldability was considered desirable, but not imperative, by the majority. So far as working qualities are concerned, however, there was general agreement that tubes should be capable of being rolled in without work hardening, that materials should not air harden, and that corrosion resistance should not be impaired by cold working. It was remarked that tubes of 18-8 chrome-nickel steel were subject to failure without preliminary warning by bulging. There was a feeling on the part of a considerable number of refiners, however, that such a warning, while valuable, was not imperative, provided that the material possessed other outstanding characteristics.

By far the great majority of chemical industries do not have to contend with excessively high temperatures, according to a paper prepared by F. H. Rhodes, Cornell University, Ithaca, N. Y. Prof. Rhodes pointed out that corrosion usually is the chief problem, and that where temperature exerts an important influence, its effect is often one of accelerating corrosion. He discussed briefly the revivification of bone char, and the corrosion difficulties attendant on high-temperature operations with various acid and alkaline materials, chiefly contact sulphuric-acid manufacture, caustic dehydration, coal-tar distillation, and ammonia synthesis. In describing the mechanism of hydrogen embrittlement he explained that the phenomenon is one of decarburization

and said that the presence of chromium in steel to resist hydrogen decreases the susceptibility to attack of the ferrite. In ammonia synthesis the chromium appears also to react with the ammonia to form a stable nitride or double nitride with iron.

In a paper on the use of metals in equipment for the non-ferrous roasting, smelting, and refining industries, R. E. Brown, Electro Metallurgical Sales Corp., San Francisco, Calif., referred in passing to the requirements for multiple-hearth roasters of the type used in burning pyrites. He stated that the rabble arms and blades usually are of cast chromium iron. Castings of 22 to 25 per cent chromium and 1 to 1.25 per cent carbon, he said, are preferable to those containing 16 to 18 per cent chromium and 0.75 to 1 per cent carbon. Straight chromium irons appear to be preferable to chromium-nickel irons.

The principal high-temperature difficulties encountered in the ceramic industries were outlined by C. E. Williams, Battelle Memorial Institute, Columbus, Ohio. The tendency in most cases seems to be to use the cheaper metals, and this usually has been done with considerable success. Corrosion from sulphur in the fuel is frequently a cause of difficulty, as well as warping and cracking from thermal strains set up in the material. In ceramic dryers, where temperatures seldom exceed 500 deg. F., steel generally is used, sometimes protected with a galvanized or protective-paint coating. In kilns the refractory protection given the metal parts is of much assistance in making ordinary steel and cast iron satisfactory. Dampers for kilns have given trouble and those made of metal-reinforced refractory materials probably are most satisfactory.

Mr. Williams further discussed the metal requirements of the glass industry. Equipment here has generally been designed to make use of air and water cooling, so that the cheaper metals can be used. Molds, he said, are made of chilled gray cast iron in most cases. Work is being done on the use of nickel- and nickel-copper-chromium cast irons. Chromium plating of molds is now better understood, and although this practice has not yielded the results expected, it has effected substantial improvement.

AS PREVIOUSLY noted, the second session of the symposium was devoted to the properties of metals and alloys, chiefly at elevated temperatures. The treatment was primarily metallurgical in its viewpoint, and in addition, not of a type that would lend itself readily to the condensing necessary for review here. Hence it is necessary to note only an occasional point which seems to be of particular interest.

Zinc, aluminum, magnesium, and copper alloys for the higher temperatures appear to have applications chiefly outside the realm of chemical engineering. In commenting on the cast carbon and low-alloy steels, R. A. Bull, of the Electric Steel Founders' Research Group, Chicago, pointed out that carbon-steel castings are commercially satisfactory in proper thicknesses for temperatures to 750 deg. F., while certain low-alloy steel castings, also sufficiently thick, are equally suitable for temperatures to 1,000 deg. He stated that such castings are as satisfactory for temperatures to 1,000 deg. as wrought steel products of comparable composition.

In regard to the wrought austenitic (18-8) alloys, R. H. Aborn and E. C. Bain, U. S. Steel Corp., Kearny, N. J., mentioned particularly the resistance of these alloys to high-temperature oxidation. The chromium content is said to be chiefly responsible for this virtue, probably because it contributes a thin but impervious film of oxide which protects the metal and is renewed in case it should be removed by abrasion. These authors pointed out that the addition of small quantities of other elements is sometimes beneficial for specific applications, as for example the addition of 2 to 4 per cent of molybdenum for improving resistance to corrosion by sulphurous and acetic acids. Increasing the silicon content to from 1.5 to 4 per cent is described as improving the resistance to oxidation and to sulphurous gases under oxidizing conditions.

Numerous other alloys of the iron-chromium-nickel series were described in detail by N. B. Pilling and R. Worthington; and nickel and nickel alloys by C. A. Crawford and R. Worthington, all of the International Nickel Co., New York City. The data are too extensive to summarize here. C. A. MacQuigg, Union Carbide & Carbon Research Laboratories, Long Island City, N. Y., commented at length on the high-chromium steels, remarking that all such alloys, up to 30 per cent chromium, are readily workable, provided that the carbon is less than 0.3–0.4 per cent; and that the alloys machine well after proper heat-treatment if the carbon content is low. They are particularly suitable to high-temperature resistance to oxidation, provided that the attacking agent is able to produce an impervious oxide coating.

AN ABLE summary of the high-temperature properties of 12 of the rare metals was given in a paper by W. H. Swanger, of the U. S. Bureau of Standards, Washington, D. C. Every member of the group includes one or more of the properties of resistance to atmospheric oxidation at elevated temperatures, resistance to most corrosive substances, and extremely high melting point. Silver and gold have good corrosion resistance, but rather low melting points. All of the platinum metals have good corrosion resistance and comparatively high melting points. Ruthenium and osmium, however, oxidize rapidly at a red heat, while rhodium, palladium, and iridium form oxides at temperatures slightly above a red heat, which later appear to dissociate at higher temperatures. Platinum is the most useful member of the group. Tantalum and columbium are very resistant to corrosion, have high melting points, but must be operated in a vacuum at high temperatures. Similarly, tungsten and molybdenum require an evacuated or reducing atmosphere at high temperatures, but neither has any special resistance to corrosive agents.

Writing on the corrosion resistance of nitrided steel, O. E. Harder, Battelle Memorial Institute, explained that this material should not be used in the presence of acids, but that it has excellent resistance to such corrosive agents as alkalis, the atmosphere, crude oil, tetraethyl lead, natural gas combustion products, tap water and still salt water. It is slightly attacked in aerated salt water and when alternately wetted and dried. It appears that the original nitrided surface offers better corrosion resistance than ground and polished surfaces.

The papers by N. L. Mochel, Westinghouse Electric & Manufacturing Co., Lester, Pa., and M. S. VanDusen, U. S. Bureau of Standards, Washington, D. C., respectively dealing with thermal expansion and thermal conductivity of metals, are chiefly addressed to the designer. It is valuable to note, however, that the first of these papers gives an extremely complete tabulation of the thermal expansions of a very large number of alloys and metals at a number of temperature ranges to 600 deg. C.

Advantages of Electric Heating Applied to Glass Lehrs

By R. M. CHERRY
Industrial Engineering Department
General Electric Co.
Schenectady, N. Y.

WHILE some electric lehrs have been in operation for many years, electric heat has in the past been considered too expensive for most of the glass that is annealed and for the majority of plant locations. But the fact that there are over a hundred electrically heated lehrs in operation, annealing various kinds and sizes of ware, and located at places where fuel such as natural gas and oil are available at attractive prices, shows that they have passed the experimental stage and are often an economical measure.

The old pan-type conveyor lehr is fast disappearing. Machine production has required that all handling from the melting furnace to the packing be eliminated. In order to do this, the so-called jitney lehr was developed and constitutes one of the principal developments in the glass industry in the past few years.

It is simply a lehr of sufficient size to take the production of one molding machine (on some type of ware, the output of two molding machines may be put through one lehr). This permits the lehr to be located near the molding machine. Most of the ware, when it leaves the mold, can be immediately placed in the lehr, although in some cases the ware leaves the mold at a temperature such that a slight amount of cooling is required first.

Glass objects are shaped or formed while the material is in the semi-molten or plastic stage, and if they are allowed to cool in the open air, strains will be set up which may be sufficient in magnitude to shatter the ware, either in the process of cooling or subsequently in transportation or in use. The object of annealing is to prevent or to relieve these strains, and the temperature required usually ranges from 900 to 1,050 deg. F., varying with the kind and size of ware.

It has been definitely determined that the strains in glass can be relieved in a very short time if exactly the correct temperature and cooling curve can be secured, and that a much longer time is required if the correct temperature and cooling curve is not accurately controlled. This emphasizes the desirability of close temperature control and uniform heat distribution. These, together with a clean atmosphere without air currents, are the chief requirements of an ideal apparatus for glass annealing.

The jitney lehr, the type used in connection with electrical heating, is smaller in size than the old pan-type lehr. Usually, it is 2 to 4 ft. wide and 80 to 100 ft. long, the conveyor being made of a lightweight woven-wire-mesh belt. The output of an average size will vary with the type of ware to be annealed, but the maximum is approximately 18 tons per 24-hr. day. In general, the 4-ft. lehr has a heating chamber from 15 to 20 ft. long,

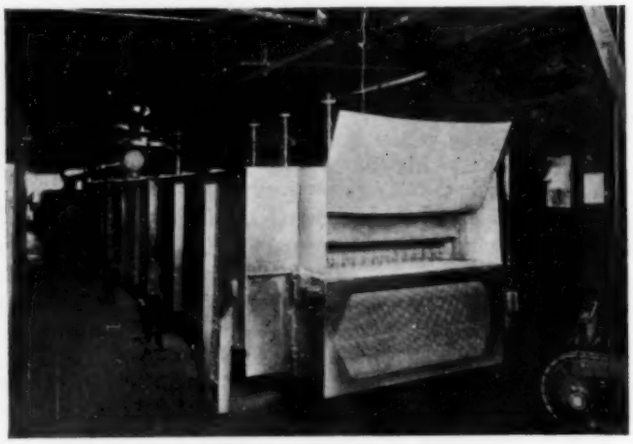


Fig. 1—Electrically Heated Lehr of the West Coast Glass Co., With Four Heating Zones

divided into three or four separate controlled circuits. In lehrs having widths less than 4 ft., the conveyor speeds usually are higher and therefore a slightly longer heating chamber may be required.

The usual rating of a 4-ft. lehr with 15 to 20 ft. long heating chamber will be approximately 80 kw., divided into three separate temperature-control circuits or zones. The power consumption will vary from practically nothing to 100 kw.-hr. per ton of glass annealed, depending on the weight of glass per hour and the entering temperature of the glass. In Fig. 2 is shown the effect of weight of glass and entering temperature of the glass on the power consumption of a 4-ft. lehr of the jitney type using a mesh belt conveyor having a weight of 12 lb. per running foot, conveyor speed of 8 in. per min., and annealing temperature at 975 deg. F.

If the user of the lehr is certain that he will not encounter any of the unusual conditions such as ware entering the lehr at considerably below the annealing temperature required, then the rating of the lehr need be but slightly above that required to supply heat losses from the lehr when idle. A safe and practical solution to this is to install sufficient connected load to take care of any conditions of heat requirement likely to be met in operation.

The total rating of the lehr is divided into several independently controlled circuits or zones, usually three in number. The first or incoming zone will have the highest rating, as it is here that the maximum heat requirements occur. The second and third zones usually are rated approximately the same, as the glass and conveyor have in most cases absorbed all the heat required during the travel through the first zone. In the second zone, usually the only heat required is that necessary to supply the heat losses from the well-insulated lehr walls in that section. In the third zone, the only heat required is that for control. The glass has started to cool in this zone and

the heat given up by the glass in cooling supplies a portion of the lehr losses and the electric heat in this section is used only for control purposes during production.

The electric heating and control equipment for a jitney type of lehr consists of from 12 to 20 heating units, each unit being independent and readily removable through a side wall of the lehr, and the necessary control panels and instruments, one of each being required for each zone. Usually four or five of the heating units are connected in series to go across a standard voltage of 220, single phase.

A heating unit consists of a heavy metallic resistor wound in short loops so as to eliminate difficulties that would occur from expansion and contraction of the element if long loops were used. The unit is supported and spaced by Alundum compound insulators, all of which are mounted in a heat-resisting alloy frame. In order to prevent the heating unit from slipping out of the spacing slot in the insulator while the unit is being handled, tube insulators of Alundum compound are placed on top of the units with sufficient clearance to permit free expansion of the units. This makes a very compact and rugged type unit, one which is easily installed or removed. Connection is made through an insulated wall plug which fills the opening through which the heating unit is inserted or removed.

It may be said that, as a general rule, top units are used only in the first zone and in many instances the top heating units in the first zone will not be required. The bottom heating elements are mounted underneath the conveyor and may be placed directly on the floor of the lehr, which usually consists of light brickwork, or may be elevated above the floor on suitable supports if desired. The heating element is a standard nickel chromium alloy as used for high-temperature furnace work and will give almost indefinite life at annealing lehr temperature.

With electrically heated lehrs, the heat is all distributed along the heating chamber, divided into zones as described above, so any temperature characteristic can be secured and automatically maintained. Furthermore, the temperature characteristics can be readily changed for different kinds or sizes of ware by adjustment of the instrument setting. This, together with a variable speed adjustment on the conveyor drive gives complete control of the annealing cycle.

The precise control of the temperature time curve permits, as stated above, a shorter annealing time, which in turn permits the use of shorter lehrs for a given width and saves considerably in floor space.

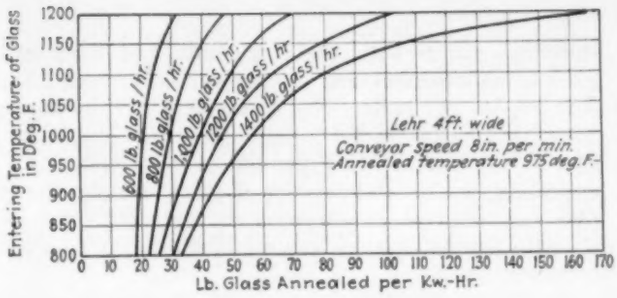

Entering Temperature of Glass in Deg. F.
1200
1150
1100
1050
1000
950
900
850
800
600 lb. glass / hr.
800 lb. glass / hr.
1000 lb. glass / hr.
1200 lb. glass / hr.
1400 lb. glass / hr.
Lehr 4 ft. wide
Conveyor speed 8 in. per min.
Annealed temperature 975 deg. F.
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
Lb. Glass Annealed per Kw.-Hr.

Fig. 2—Power Consumption in Electrical Lehr as Function of Entering Temperature and Production Quantity

The fact that the atmosphere in the electric lehr is always clean and sterile is of considerable importance, as it means that no cleaning is required and the ware can be packed directly from the lehr conveyor. The elimination of the subsequent cleaning operation, such as is often required on certain classes of product, may be of more importance in so far as cost is concerned than the total annealing cost.

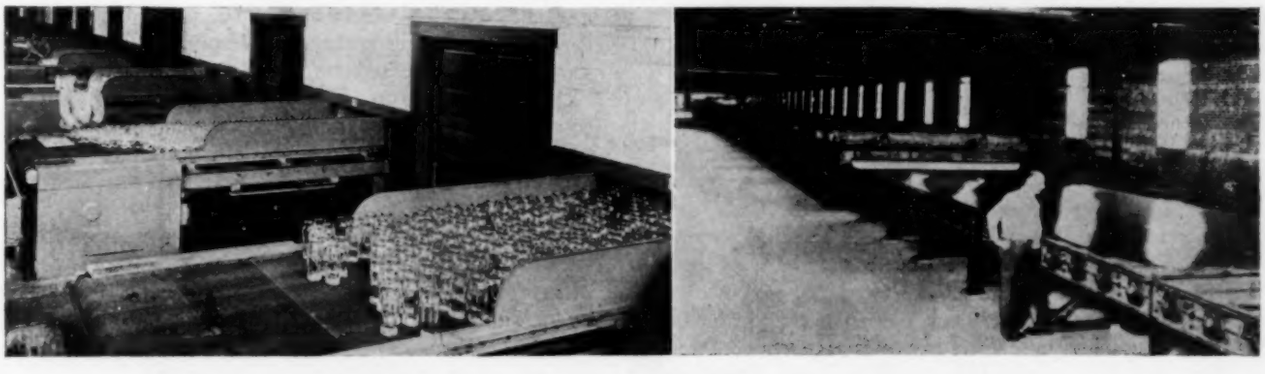
The many electrically heated lehrs now in operation are being used for an endless variety of ware. In Fig. 3 is illustrated part of an installation consisting of a total of 14 electric lehrs, each having a conveyor 4 ft. wide. They are used for the annealing of various types and sizes of bottles and jars and the entire output of this plant is annealed electrically.

In Table I are data covering a record of five months' operation in a plant having 13 electric lehrs in operation. It should be borne in mind that these data represent over-all operating conditions which included various types and sizes of ware, heating up after idle periods, and the like. The average economy given in this figure for the five months' period is shown as 57.5 lb. of glass annealed per kw.-hr. This is equal to 35 kw.-hr. per ton, or at 1c. per kw.-hr., an average cost of 35c. per ton of glass annealed.

The use of electrically heated lehrs has extended to the plate-glass industry, where about four have been installed to date. One of these lehrs is shown in Fig. 3 and has been described in *Ceramic Industry*, February, 1930. The inside dimensions are 13 ft. 6 in. wide, 730 ft. long, and the heated portion is approximately 400 ft. long, divided into a total of twelve independently controlled circuits in the length of the heated portion.

The glass enters the lehr in sheets approximately 12 ft. wide, each representing the contents of one melting pot, usually about 3,000 lb. The hourly output of the lehr is about 8 pots, or 12 tons of glass. The power con-

Fig. 3—Left: A Portion of Battery of 14 Electrical Glass Lehrs at Discharge End. Right: A Sheet of Plate Glass Emerging From Lehr of National Plate Glass Co.



sumption varies with the production and thickness of glass being annealed, and usually varies between 250 and 300 kw.-hr. per hour. For a production of 12 tons per hour, this means in the neighborhood of 25 kw.-hr. or 25c. (at 1c. per kw.-hr.) per ton of glass annealed. At annealing cost of 25c. per ton of glass entering the lehr, this means a cost of approximately $0.00064 per sq.ft. of ¼-in. finished plate glass, or about 16 sq.ft. of glass annealed for 1c.

Another plate-glass lehr placed in operation a few months ago takes sheets 6 ft. 6 in. wide. The lehr has a total length of approximately 650 ft. with the first 340 ft. heated. The total rating is 700 kw. divided into 17 independently controlled zones, each 20 ft. long. The power consumption varies usually from 30 to 60 kw.-hr. per ton of glass annealed, depending on the thickness, weight, and entering temperature of glass.

Another feature of the electrically heated plate-glass lehr is the shorter time required to bring the lehr up to operating temperature after a shut-down period. In a fuel-fired lehr, requiring heavy refractory and high temperature in the combustion chamber, the lehr must be brought to temperature slowly, often requiring many days, due to the expansion problem encountered. In the electrically heated lehr in which only light-weight bricks are used and where the temperature of the heat source (temperature of the heating element) is only slightly above the required annealing temperature, the expansion problem becomes minor, thereby permitting bringing the lehr up to operating temperature in a much shorter time than the fuel-fired lehr.

Table I—Record of Operation in a Plant Having 13 Electric Lehrs

Month	No. 1	No. 2	No. 3	No. 4	No. 5	Average for 5 Months
Working days per month	23	28	23	25	27	25.2
Average number of lehrs per day	9	8.6	8	12	13	10.2
Total lehr days operated per month	207	240	184	300	351	257
Kw.-hr. per month	80,230	93,690	66,862	115,550	113,230	93,910
Kw.-hr. per lehr day	387	390	364	385	322	370
Total tons glass per month	Not available			.....	3,800	2,700
Lb. glass per kw.-hr. average	Not available			.....	67.2	57.5

There are many special applications for electrically heated lehrs, such as the annealing of X-ray and large vacuum tubes. For annealing lenses and prisms, the electric furnace lehr is almost a necessity. Usually the annealing cycles are long and the temperature time curve requirements very rigid. An extreme case of annealing optical glass was one requiring nine months to anneal (reported in *Chem. & Met.* February, 1928). This was a one-piece glass casting 70 in. in diameter, 11 in. thick, and was made by the Bureau of Standards. The disk was used for a telescope mirror.

The lehrs for decorating glassware are essentially the same as for annealing. Since the ware is cold when placed in the lehr, the heating rate must be relatively slow and definitely controlled. Such a lehr will have from four to eight control zones, depending on the size of the lehr and type of ware. The zones are divided into heating, holding, and cooling. The usual maximum temperature to which the ware is heated is approximately 1200 deg. F.

▼ ▼ ▼

Protective Coatings for Pipe Lines

SPEAKING at the joint production and chemical conference of the American Gas Association in Philadelphia, on May 22 (a report of which appeared in the last issue of *Chem. & Met.*), H. A. Gardner, director of the Institute of Paint and Varnish Research, gave an excellent critical survey of protective coatings for subterranean pipe lines, that incidentally showed what the chemical engineering industries are producing to help chemical engineers themselves. He began with the assertion that the present steel pipe lines still offer best all-round satisfaction, but needed protective coatings, fulfilling as nearly as possible these ideal conditions:

Relatively inexpensive.
Easy to apply during all seasons without special equipment.
Resistance to soil waters.
Contact with soil without deformation.
Non-conducting in nature.
Adhesion during settling of soil or expansion of pipe.
Stability between 0 and 175 deg. F.
Adhesion to standard top coats.
Resistance to shock of backfilling without injury.
Adaptability to patching during repairs.
Resistance to acids, alkalis, and petroleum oils.

Testing is best carried on on a large scale, but it usually is more feasible to use the method developed by the American Petroleum Institute and the Bureau of Standards, in which small 14-ft. pipe is covered as desired and buried with check pieces in certain localities. Mr. Gardner also described his own accelerated test.

Applying the accelerated test to systems developed in his own laboratory, Mr. Gardner found ten which were especially successful. Five had a zinc chromate primer applied both hot and cold, and subsequently coated with a wide range of other materials, such as viscose, pyroxylin, varnish, rubber tape, aluminum foil, and in one case a metal jacket. The other five were all inserted in metal jackets, the intervening space being filled with sulphur, zinc dust, paraffin, diphenyl resin, cement, rubber, and resin. The jacket developed in Mr. Gardner's laboratory consisted of two parts which are snapped together around the pipe, buttons of zinc providing a uniform space of ⅜ in. to be filled out with various substances.

In connection with the National Tube Co. a series of tests was undertaken to find a semi-permanent transparent coating for the pipes prior to their installation. The results are briefly indicated here:

Raw Oil Paint—Drying too slow; durability high.

Oleo-resinous Varnishes—Low oil content gives poor durability; high tung oil and pigmentation give durability, but higher cost.

Heat-treated Oils—Certain mixtures of drying and tung oils gave excellent results, especially when combined with highly dispersed zinc chromate.

Synthetic Resins—Highly durable and resistant, but cost is more justified under special conditions.

Asphalt Varnishes—Failed when exposed to sun.

Nitrocellulose Compositions—Apart from fire hazard, showed many mechanical advantages.

Wax Oils—Satisfactory, but no special advantages.

In summary, the most desirable coating for storage protection of pipe was found to consist of 90 per cent oil base, three-fourths being tung oil and the remainder other oils processed together under heat; and 10 per cent zinc chromate, the latter finely dispersed.

Industrial Markets for Chemicals Require Special Study

By RAYMOND B. LADOO

U. S. Gypsum Co., Chicago, Ill.

MARKETS for minerals and chemicals may be divided into a few broad classes or groups in which the problems of market development, sales, and the other phases of the general problem of distribution differ quite sharply one from another. The most important of these groups are: (1) industrial, (2) construction, including buildings, roads, dams, etc., and (3) agriculture. In groups (2) and (3) the range and varieties of products and problems are much more limited than in group (1). Building materials, in the main, comprise a relatively small number of well-defined products, such as portland cement, lime, gypsum plaster, paints, brick, tile, and metals. Agricultural chemicals and minerals are still more limited in number and modes of use and application. In this group fall all the chemically prepared fertilizers, the mineral fertilizers and soil conditioners, as well as insecticides and fungicides. While the problems of marketing in these two groups are many and difficult, it is the purpose of this paper to discuss only those of the most diversified and complicated group; that is, industrial marketing.

In the industrial group are included the chemicals and minerals and their primary products which are used as raw materials or intermediate products in the tremendous number of industrial processes and plants in the country. The mere listing of all or even a major part of the industries which use minerals and chemicals in an important way and of the most important of such products which each industry uses would be an almost endless task. But to go further and obtain data on types, grades, qualities, and prices on each material for each use, together with approximate annual consumption for each, would be almost if not quite impossible. Yet if such a census of industrial-material utilization could be prepared and be kept reasonably up to date, how extremely valuable it would be in our whole scheme of research, production, and sale of industrial commodities!

Formulating Prospective Fields

Our federal government does furnish us with much valuable data on this problem—much more than most people know about or make adequate use of—but much of it is too out of date by the time it is published to be of much more than historical value. Furthermore, governmental data are and must be non-critical and they are usually not sufficiently detailed and subdivided into quality, price, and customer groups to give much indication of just where, what materials may be sold and how, and when, and for how much. Yet the statistical publications of the bureaus of the Census, Standards, Mines, Foreign and Domestic Commerce, and so on afford considerable valuable data for more general surveys.

The need for market data may arise in a number of different ways, but such data are essential to any orderly and systematic attempt at the development of wider markets. A company may seek to widen the sale of an established product by finding more customers in the same sales channels. It may seek new applications for present products. It may seek to improve or modify present products to fit them for other uses. It may seek markets for waste products or byproducts or for entirely new and hitherto unknown products developed by research. It may want to grow and develop into new lines, the better to balance its operations and diversify its interests, and it may need the market pictures of several commodities and industries in order to make a wise choice. The question may arise, "Should we concentrate on an industrial market—such as, say, the textile field—and make a line of products to be sold primarily in that field in order to make our selling problem easier and cheaper; or should we make a line of similar and related products from one or a few raw materials in order to simplify production problems; should we produce and market on a national scale or concentrate in some one section of the country?" These problems do not always arise in concrete form, but they exist in any company which is expanding or even holding its ground today. Often companies would be better off if they would formulate their problems in a concise way. A long step toward the solution of a problem is made when it is clearly set forth.

That this problem of industrial marketing is a very live one today is shown by many advertisements and articles in technical magazines describing entirely new products for which markets are sought. New products usually drive out old ones, and other markets must be found for the replaced products. Only infrequently are entirely new finished products developed, to satisfy newly created wants, and providing really new, additional markets for raw materials. When they do come, however, they are likely to be of very great importance; witness the automobile, radio, and the moving pictures.

Industrial Markets More Stringent

Not only is the industrial group a far more diversified one than the other two but its marketing problems are very different. The use of fertilizers in general may be stimulated by education, by demonstration, and by advertising to farmers. The sale of building materials,

either direct to the ultimate consumer or through dealers. may also be stimulated by advertising, and there is no definite limit to the size of markets which can be created if enough time and money are spent in the task.

There are very definite, absolute limits to the sales of raw materials to industries. These limits are set by the demand for the finished product in the production of which the chemicals or minerals are used. Lime can be sold to leather or glue makers only when and to the extent that there are markets for leather and glue. Only by stimulating the ultimate consumer use of the finished products could the raw materials producer expand his ultimate market, and this usually is a far too difficult and expensive thing to undertake.

Industrial chemicals and minerals usually play a small but vital part in a finished product or process. The cost of the raw material may be an insignificant part of the cost of the finished article, yet it may be absolutely essential, and high standards of quality and uniformity may be insisted upon. The producers of the raw materials, therefore, have to make carefully controlled, high-quality products and sell them at a low price under highly competitive conditions in an absolutely limited market to relatively few possible customers. Chemical lime is a very good example.

Determining Desirable Prospects

While it is important that a producer of any commodity have a good understanding of his market possibilities, it is clear that the producer of industrial chemicals and minerals needs a more detailed, accurate picture of his markets than producers in many other lines. It is not important that a maker of chewing gum know the names and tastes of all present or prospective gum chewers, but it is highly advisable that a producer of crushed gypsum for portland cement retarder know of every portland cement plant within his shipping radius. One plant missed may be the largest user in the lot.

Another point which is well worth noting here is the relative amounts of time which can be profitably spent in gaining a single customer in the different groups. In the industrial group nearly all business is "repeat" business, in large, more or less steady volume, and often done on an annual contract basis. Customers are far fewer and individual accounts are, on the average, far larger than in the other groups. For example, in one industry the average customer buys nearly 10,000 tons of a commodity per year. In the agricultural group, the average customer buys less than 30 tons per year of an analogous commodity, and in the building material group the average is even less. In sales valuation the differences are not quite as marked, but still are very great. It is probably safe to say that in many industries one average customer will buy, in dollars of sales valuation, from ten to a hundred times as much as an average customer in the other two groups. The gain or loss of a single industrial customer is vastly more important than such an event in the other fields.

This is one important reason why industrial sales may not be compared with sales in, say, the building material field or judged by the same standards. It may be good business to spend a year or two years of continuous sustained effort to "land" an important industrial account. Repeated calls may result in no visible progress which can be shown on call reports, but which may be slowly but surely leading up to very important sales. It is very rare, indeed, that an important industrial sales can be made on the first call or on the second or third.

Probably what has been said so far (and, for that matter, much of what will be said later) will be considered so simple, so elementary, and so self-evident that it is hardly worth while to set it down. Undoubtedly, many of the larger and more systematic companies fully understand and apply the principles here discussed, but, on the other hand, it is certain that many companies do not appreciate or apply them at all.

As an example let us take a hypothetical but typical case. A company has been selling a commodity to an industry for many years. Sales have reached a volume of about 30,000 tons per year, and the company supposes it has about 60 per cent of the total available business in that line. It has records and lists of consumers of a sort, and suppose it is doing a good job of selling. No systematic study has been given the subject, however, and only irregular spasmodic checks are made of business gained or potential business—one day, perhaps, someone is running over the tabulated records, checking freight rates, and he finds errors and inconsistencies in rates which lead him to suspect there are other errors, both of commission and omission. He quietly starts a survey of possible customers and their annual requirements and of the total tonnage used by the industry. He finds that many important customers have been entirely overlooked, that estimated tonnages are from 20 to 75 per cent too low, and that the total tonnage used by the industry is over 100,000, instead of 50,000, as had been supposed. The company had been getting only 30 per cent of the business instead of 60 per cent. When some of the non-customers are called on later, it will probably be found that they had *never* been called on by anyone from the company. This is by no means an unusual or exaggerated case; many more similar examples taken from many companies could be cited.

This brings us to one of the most fundamental principles of efficient industrial selling.

Necessity for Systematic Records

No one likes to keep records—paper work, red tape. Salesmen, managers, and clerks all dislike the regular, systematic keeping of records. Not financial records—bookkeeping, that is accepted as essential—but lists of names, reports of calls, complaint records, data on tonnage used (estimated or actual shipments), specifications, containers, car routings, and so on. Appreciation of the value of adequate records and of the keeping up to date of such records is hard to instill into an organization. The routine work usually must be done by clerks who do not know what it is all about and "higher-ups" often have no use for records. They prefer direct action. They value much more the going after a single, definite prospective order than the slow, dull routine of preparing a systematic approach to a much larger volume of prospective business.

Digging up obscure data is not spectacular; it is slow and it doesn't produce immediate profits. Even after important new business is gained as a result of this slow, systematic study, the "build-up" is often forgotten and as little use as ever is had for the "non-productive" work.

Groundwork of Sales Development

The preparation and maintenance of adequate sales development records involves both office work and field work. Some of the more important steps in the building up of such records for a typical commodity are outlined below:

1. Preparation of suitable blank forms for the collection and keeping of data.

2. Assembling on the blank forms all pertinent data available on present customers or known users of the commodity. Such data should include:
   (a) Name of company.
   (b) Location of plant or plants.
   (c) Location of buying office.
   (d) Names of plant superintendent, chief chemist, purchasing agent, or other officials who should be seen.
   (e) Product or products made in which or in the production of which the commodity is used.
   (f) Estimated (or actual) annual tonnage required.
   (g) Price and how figured; contract (terms) or spot.
   (h) Freight rates from own producing point and competitive producing point.
   (i) Railroad delivery point and preferred routing.
   (j) Customers' specifications.
   (k) Shipments by months over past few years and with space for future shipments, for several years.
   (l) Record of calls on customers (names and dates only).
   (m) Record of complaints and how settled.

(All data subject to rapid change, such as prices, tonnage requirements, etc., should be dated and kept current.)

3. Preparation of complete check lists of all customers and possible customers, from company records, trade and other directories.
4. "Breaking down" of check lists by sales divisions or salesmen's territories.
5. Calling on all consumers and developing further data needed.
6. Completion of blank form record on individual customers.
7. Preparation of summarized master lists of all known users and checking total tonnage "located" against total estimated or known tonnage used in the country.
8. Running down, in the field, of discrepancies revealed in 7.
9. Arranging for systematic recording and tabulation of orders entered and shipments made (from loading tickets or bills of lading).
10. Systematic checking of actual shipments against customer shipping schedules, to be sure there are no delayed or missed shipments.
11. Checking of actual shipments to each customer against those of previous month and of same month in previous year to detect loss of customers or "splitting" of business.
12. Systematic checking of trade publications for data on new plants built, increases in plant capacities, changes in personnel, in order to keep records up to date.
13. Systematic recording of salesmen's calls and checking of call reports.
14. Periodic checking (monthly or oftener) of customer data sheets for tonnages shipped and frequency of salesmen's calls to locate any weak spots.

All this probably looks like a very elaborate and useless time-consuming routine, which it isn't in the least. A system (with its blank forms and methods) set up for one commodity or one consuming industry may be made to apply almost without change to many commodities and many industries. Once the forms are developed and the records are properly set up, the actual keeping up of the records requires little time. The periodic checking up of the data requires more judgment than time. Without adequate records it is surprising how easy it is to lose tonnage here and there, to lose a customer from inattention or the careless handling of an order. Without good records and systematic checking up a lost customer may be lost sight of for months or years, due to change in sales personnel.

Markets for New Products

What has been said so far applies particularly to the maintenance and extension of business in already developed commodities for established uses. The development of new uses for old products and new uses and markets for new products is a much more difficult task. But here again the systematic approach is just as important, and, in part at least, the same general methods may be used. Where a product is developed for a specific use, at least one industry is immediately open for systematic study. But where markets are being sought for a waste product or for a byproduct or for a newly discovered product, no immediate markets may be found. Here a wide knowledge of industrial processes and methods and raw materials is almost essential in order to discover promising "leads." Even a wide industrial experience is often not adequate to the task unless other aids be brought to bear on the problem. Luck, too, often plays an important part —important discoveries are often more or less unforeseen.

One of the greatest aids in finding new uses for a product is a complete charting of all of its physical and chemical properties; that is, such properties as are commonly measured and tested and any known unusual properties. This would seem almost an axiomatic essential, yet countless products are launched or offered on the market without any specific data as to their properties. The attitude in substance is, "Here is a new product we would like you to buy. We don't know anything about it or how it will work in your plant, but we hope you can use it." The purchasing agent asks for samples as the easiest way out. And when they come, how often do they slide off into the waste basket or find their way, with others of their kind, into oblivion on a laboratory shelf?

"Either the product is no good, or the price is too high, or our salesmen aren't worth a damn." Thus the research director of an important corporation after a two months' sales introduction of his new product. As a matter of fact, he was wrong on all three counts. It takes time to convert the industrial market, and in this case the salesmen happened to be making really good progress by preparing a sound, studied foundation.

It is true that many new products eventually gain a foothold and succeed without detailed preliminary study of their properties or systematic market development. But how many really meritorious products fail and disappear for years, until a definite need appears or some energetic person rediscovers them, because they were not properly launched? And how many products achieve only limited use, when a thorough, energetic study would develop far wider markets?

Correlating Sales and Research

The more progressive companies today realize all this and provide for adequate research and product development. They also realize how important the time element is. It may take a year or two years or five years of

persistent work to develop profitable markets for a product of really outstanding merit. To people not familiar, through their own experience, with the difficulties and exasperating delays involved in "putting across" a new industrial product this time element is one of the most difficult to appreciate. They are so eager for "results" in the form of tonnage sales and profits that they cannot understand why a good product is not instantly salable. Even research workers, accustomed to the setbacks and delays in the solution of their problems, sometimes do not appreciate the difficulties of practical application and industrial sales development.

Another point which does not seem to have received much consideration is that of the proper ratio between laboratory research effort and effort put into market and product development in the field. By market development is meant taking a product, developed by the research staff, into the field, surveying possible markets, calling on possible potential customers in several industries, getting plant laboratories to test it, discovering and overcoming difficulties found both in the product and in plant practice, making actual sales, listing and calling on all possible buyers, and getting general trade acceptance, so that the regular salesmen can handle it as an established commodity.

Some companies do not try to bridge the gap between research and sales, but attempt to sell, in a routine way, products just as they come from the research laboratory. Other companies recognize that there is a gap to be bridged, but attempt to do it with two or three field men. Still other companies meet the problem by setting up separate departments or even subsidiary companies to introduce new products.

Good ideas are common. One imaginative man can in a day think up enough research problems to keep several men busy in a laboratory for months. A few industrious research workers can often devise and partly develop enough new products or variations of old ones to keep a large field force busy, trying to introduce them and complete their development. Just what ratio should prevail between research effort and market development effort is hard to determine, but it seems clear that at least as much emphasis should be laid on the development of markets for a product as on developing the product itself. A product is not of much use commercially unless it can be and is sold.

Technique of Market Prospecting

Some of the things which are worth while doing in seeking markets for new industrial materials are:

1. Determine accurately and tabulate all of the commoner physical and chemical properties of the material, together with unusual or unique properties, common reactions, and all available data which might assist in determining its fitness for specific uses.
2. List suggested uses and, for each use, tabulate material now used, with its essential properties and comparison with new material.
3. Make preliminary, partial, or "sample" market surveys of most promising industries to determine approximate size and attractiveness of markets, prices, competitive conditions, and so on.
4. Determine in research laboratory or by cooperative testing in industrial laboratory or plant the general suitability of the product for the suggested use, in order to develop it further or modify it to make it more suitable. Too often new products are offered to the trade "as is" without any special effort to fit them to specific uses.
5. Keep the consumer's viewpoint and needs to the fore, rather than production problems. The first step is to make a product best suited to consumers' needs, and the second is to develop a method of producing it most economically.
6. Give wide publicity to the product by advertising its outstanding properties and a few suggested uses. The industrial field is so very large and diversified that no one man or group of men can know of all of the possible industrial applications for a new product. Thus, advertising of this type is not primarily to sell but to develop new "leads," stimulate thought and discussion, and pave the way for more precise and concentrated efforts in the most promising industries.
7. Make adequate record of all samples sent out and provide for a periodic and systematic follow-up of samples, until definite results are obtained. A vast number of samples of all types of things are broadcast without any adequate follow-up to see just how satisfactory they are or why they are unsatisfactory.

To do all of these things which have been suggested requires time and men and money. Yet they must be done before it can be known definitely whether or not a new product may be marketed profitably. The market development stage is less spectacular than the other two phases, research and sales. Yet it is a vital link in the chain and must be adequately and sympathetically provided for if new industrial products developed by research are to reach, through sales, their fullest possibilities. Market research and market development are just as vital, just as fundamental, as laboratory research and must be budgeted for just as adequately as laboratory research or advertising, if a company is to grow through new-product development.

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Safe Practice Data for Chemical Industries

ACCORDING to the *Industrial Accident Statistics*, 1931 Edition, published by The National Safety Council, an ever greater responsibility for safe practice is being shown now than formerly. For 1931, 211 chemical plants reported accidents and thus exceeded any previous year.

It was found that employees in these plants worked over 204,000,000 man-hours, which, however, is slightly less than the exposure of 206,000,000 man-hours reported by 172 plants for 1929. Figures for all industries show that man-hours worked declined about 17 per cent from 1929 to 1930.

During 1930, there were 15.50 lost-time injuries for each million hours worked in the industry; these cases resulted in 1.94 days lost time for every thousand hours worked. These rates compare very favorably with a frequency rate of 18.47 and a severity rate of 1.97 for industry as a whole. In a list of 28 major industries, the chemical industry ranked tenth on the basis of its frequency rate and fourteenth in severity.

Plants engaged in the manufacture of carbon products led all other divisions with a frequency rate of only 5.05. Three of these plants have records of two years without a lost-time injury; one employed 226 people that worked over 500,000 man-hours during 1930. Establishments engaged in the production of various industrial gases, on the other hand, had the lowest severity rate, 0.20. Coal-tar distillers had the highest frequency rate, 44.72, and manufacturers of explosives had the highest severity rate, 4.03. Injury rates were high also in soap, pharmaceutical and fine chemical manufacturing, and paint and varnish manufacturing plants.

It is indicated that, as chemical plants increase in size, their injury rates decrease, a situation more or less common to plants in all industries.

Fig. 1—Mechanical Layout of Three-Calender Train; Regulating Rheostats Are Visible Above the Gear Guards

Synchronizing Operation of Calender Trains

By R. G. LOCKETT

Engineering Department
Cutler-Hammer, Inc.
Milwaukee, Wis.

IN THE manufacture of coated fabrics, such as window-shade material and rubber-tire fabric, the material being coated usually is run through a number of machines in sequence. It is common practice to drive each machine in a synchronized group by an individual electric motor, because of the flexibility of handling that is secured by this arrangement.

The control problem thus centers around the necessity of handling a group of motors in unison at various speeds and at times arranging for adjustable "draw" between units. While the problem is quite similar in various industries, where cloth is to be printed, paper to be coated or calendered, or a fabric is to be coated, yet the requirements in the various industries differ in detail, and the variations encountered have led to the development of specialized controls that are not similar. For example, rubber-tire fabric calenders ordinarily are driven by two to one direct-current motors operating on a two-voltage system, while some forms of textile-printing machines operate on a variable-voltage direct-current system providing a much greater speed variation. Each type of control provides certain special features that have been found desirable in a particular industry. In this article the special features of rubber-calender train operation are described.

Manufacture of rubber fabric for automobile tires usually is carried out by passing the fabric through successive calendering operations—a group of calenders

operating together forming what is called a "calender train."

The cotton forming the base of the fabric is fed through two or three calenders in succession, so that rubber is placed in the meshes of the textile, forced through from both sides, and smoothed. In this operation the rubber from the two sides actually meets, and forms a solid bond. Details vary in different factories, and with the material being handled, but from the control standpoint, a number of individual calender motors must be handled simultaneously from one master at a constant average speed. In some calenders, the two rolls through which the fabric passes rotate at different speeds, so that the rubber is forced into the cotton fabric. In each machine, however, there is at least one roll touching the fabric, whose surface runs at the same speed

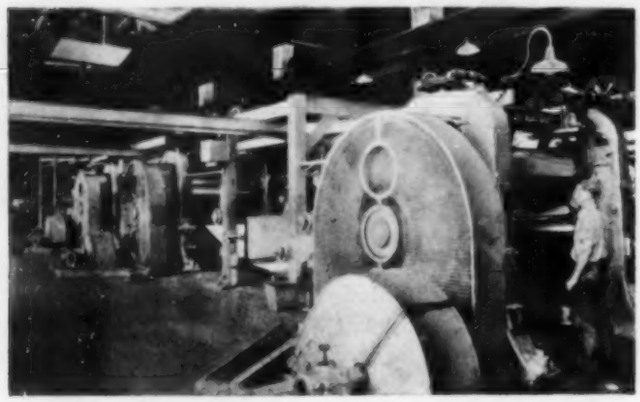


Fig. 2—Three-Calender Train Showing General Arrangement of Dancer Roll Rheostat and Festoon Between Two Calenders

as the linear travel of the cloth. The control problem, therefore, is always to operate the calender motors so that the rolls in contact with the cloth keep in step.

It is common practice in the rubber industry to use direct-current motors to drive each calender, so as to get close speed regulation over a fairly large range without undue complication. The usual supply lines provide 115-230 volts on the customary "three-wire" system. This makes it possible to get a two to one speed range by connecting the motor armature first to the 115-volt lines, then to the 230-volt lines. Shunt or compound motors, with a shunt field capable of two to one speed regulation by shunt-field rheostat are used, and in this way a total speed regulating range of 4/1 is secured economically. Thus, the ordinary calender is equipped with a 2/1 motor, which is handled by a two-voltage controller.

If the calender motors were given a very close-fixed speed adjustment, it might be thought that this would be sufficient, and that the fabric would pass through the calenders satisfactorily. However, any small error that might exist would be cumulative in character, and the fabric would either pile up in an unmanageable loop, or tighten up between calenders until an excessive tension developed. If the material being handled were fragile, like wet paper pulp in a paper-making machine, the different motors in the drive could be controlled very accurately, so that the speeds would scarcely vary. The cotton fabric possesses considerable strength, however, and this permits a marked simplification in the control. The fabric leaving a calender is passed over a set of three rolls before entering the next machine. The first and third rolls are fixed, while the second is free to move upward between them. This movable roll operates between vertical guides and presses against the fabric, being actuated by weights or a compressed-air piston.

Thus, a festoon of material can be made to form between any two calenders, and the manner in which this festoon increases and decreases indicates how the calender speeds are changing. For a number of years it has been the practice to station operators at these festoons, with one or more manually operated field rheostats arranged for convenient operation. It was the duty of these operators to hold the festoons within certain limits, by making adjustments, manually, in the motor speeds. If possible, one operator was mounted in a pulpit located so that all festoons were visible. When such an arrangement was not possible, due to layout of the machines, an operator was stationed at each festoon. This manual regulation has not been uniformly satisfactory, because a moment's inattention is often sufficient to run the loop to one extreme or the other and cause an expensive stop. An unnecessary stop reduces production and may spoil material, due to tearing or marking. When a calender is stopped with material in the rolls, the roll pressure makes an undesirable mark in the rubber and causes subsequent rejection of a number of bias strips. (The fabric is later cut on the bias into narrow strips, so that a mark extending the full width of the fabric spoils a large number of strips.)

NECESSITY for lowering production costs has brought about adoption of automatic regulation for calender trains. The arrangement is shown in Fig. 2, where the movement of the loop, or festoon, is used to drive a rheostat in the field circuit of a calender motor. As can be seen, the material, starting in the machine marked No. 2 has been coated with rubber on one side only, and is passing through the loop to calender No. 4. The upper side of the loop shows white, and this side will pass through calender No. 4 next to the roll carrying rubber.

The inherent strength of the material is of advantage in simplifying the control, the movable roller carrying the loop being connected mechanically to a rheostat arm, so that the rheostat makes its complete travel when the loop is moved from one extreme to the other. A limit switch is provided at each extreme of the festoon-roll travel, to stop the entire train if the festoon, due to some unforeseen cause, becomes too large or too small. Thus, no attempt is made to hold the instantaneous speeds of the calender motors to a fixed value. Small speed changes occur from time to time and act to increase or decrease the amount of material in the loop. When the quantity of material changes, the center roll travels up or down, and this movement applies the proper correction in the control. This correction is applied regardless of the speed point on which the train is operating. The corrective action, therefore, is such that the average motor speed is held to the proper value. The rheostat mounting is shown in Fig. 3.

Successful operation of an automatically regulated calender train is dependent almost wholly upon proper motor data and suitable control design. Allowance must be made for "lead" in the first machine, and stretching of the material as it passes through the train.

The first calender in the combination is the lead machine and is, in effect, the pace maker. A small amount of lead is provided at this point, to insure the formation of a festoon as the material leaves. This lead can be

arranged for by a slight change in the gearing between the motor and the calender, or by a small permanent step of resistor in the motor field.

A winding drum driven by a motor much smaller than the calender motors is often synchronized with the train, and the speed-torque characteristics of the small motor may vary considerably from those of the large motors. Such differences in characteristics must be taken into consideration. Automatic regulation is often applied also to trains equipped with older motors, and it is sometimes necessary to match old motors with those designed more recently. With the proper data at hand, no difficulty is encountered in operating a train with motors of different characteristics, and automatic regulation has been successful wherever applied.

Rubber calenders must often be operated for short periods as individual machines. For this reason, each motor in the combination is provided with an individual master controller, such as the one shown in the center in Fig. 3, to the right of the operator. By throwing a suitable transfer switch, any calender motor may be taken out of the train and operated as a unit. To the left of the operator is shown the "grand master," used to control all motors in the train simultaneously. From this station, the motors are started and stopped and the speed is regulated. When desired, pushbuttons for stopping and starting are available, and when pushbutton stations are installed, the drum master becomes a speed-setting station.

Two kinds of stops are available on this type of control. When a service stop is desired, the master handle is turned to the off position, or the stop button is pressed. This operation stops all motors in the train, a slight amount of dynamic braking being applied to the motors to reduce the stopping time. When an emergency stop is desired at the calender rolls, a safety switch or emergency stop station mounted on the calender at the top (shown in Figs. 2 and 3) is operated by pulling a rope extending across the working face of the calender. Operation of any safety switch on any calender in the sequence brings the whole train quickly to a stop by the application of graduated dynamic braking.

PROVISION for quickly applying high braking torque is desirable, because of the hazard to the operator in the revolving rolls. A limit switch is provided at each extreme of the festoon-roll travel, to stop the entire train if the festoon, due to some unforeseen cause, becomes too large or too small.

Provision is made in calender train controls for easily transferring the overload relays, undervoltage relays, stop stations, and so forth, when a motor is put into a train or taken out. When the motors are in a train, an overload on one motor, for example, must stop all motors, and not just the one on which the overload exists. Similarly safety switches must be transferred so that when a motor goes into a train, the stop stations on it will become effective throughout the train. When a control is operating as an individual machine, the loop-operated rheostat associated with it, of course, is removed from the circuit. The various circuit changes required are arranged so that operation of a single transfer handle per motor is all that is required to place it in a train.

It is often advantageous to "thread in" a sequence on the individual controls, handling one motor at a time, and a simple mechanical device on the transfer switches makes it possible to pre-set the combination in advance. In this way the operation of one master-transfer handle puts all motors selected in train in one operation. It is usually desirable also in this operation to change over while running, and an overlap point on the transfer switches makes it possible to pre-set the grand master drum to the same speed point as the individual masters, and transfer without an appreciable change in speed. It is of interest that the calenders and controls were operated in train on production without any circuit changes or rheostat modifications. Preparation for production consisted of threading in, throwing over to automatic operation, and coming up to full speed. Festoons automatically take up the proper position, and maintain this position throughout the regulating range. Full credit for successful initial operation should be given the engineering department and its installation crew, the high quality of the work being evident from the illustrations. The equipment illustrated is in the Cumberland (Md.) plant of the Kelly-Springfield Tire Co.

The take-off end of this train is shown in Fig. 1. This view shows the mechanical layout of the whole train. Regulating rheostats are visible above the gear guards. Inasmuch as the regulating rheostat is the heart of the automatic scheme, a detailed description is of interest. When the material being regulated is very light and easily damaged—for example, some kinds of rayon—the rheostat designer is forced to sacrifice strength and weight, and build a rheostat that requires a very low torque and has light contacts. Tire fabric is relatively strong, and the load represented by a sturdy rheostat is negligible.

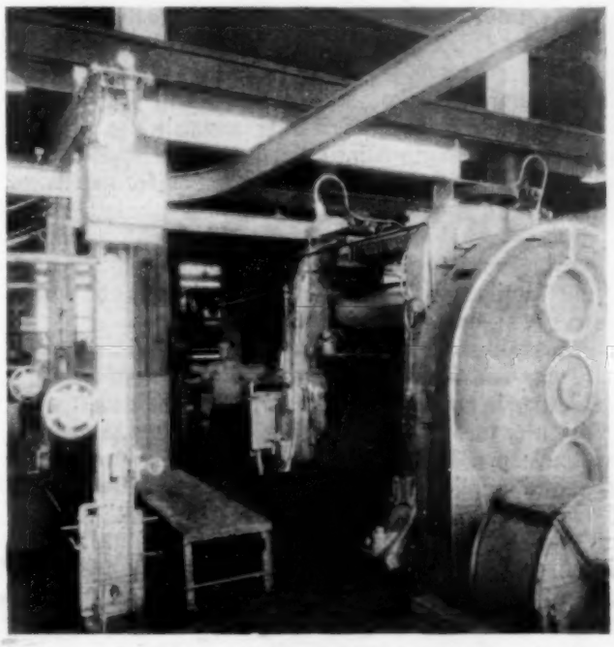
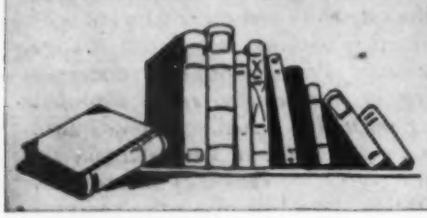


Fig. 3—Dancer Roll Frame Equipped With Overtravel Limits; Grand Master for the Train and One Individual Master in Background

Stationary contacts are segments instead of buttons, and the shoe is of carbon, and generously proportioned. The contact dimensions insure long life with a minimum of maintenance. The lever is equipped with two roller bearings and is packed with grease, so that lubrication is required infrequently. These rheostats move a small amount almost continually and although the arc of travel is very short, ample contact material is essential. Also if the motors are closely matched, the rheostat may operate over a small number of segments most of the time, and so it is desirable that the effect of wear be minimized.

Chemical Engineer's Bookshelf



Chemical Inventions

PATENT LAW FOR CHEMISTS, ENGINEERS AND EXECUTIVES. By *Fred H. Rhodes.* McGraw-Hill Book Co., New York City, 1931. 207 pages. Price, $2.50.

Reviewed by R. F. HATCH

THE OBJECT of this book is to give men in technical and administrative work a general knowledge of the law of patents. It starts with a brief history of the development of patent law and it discusses, briefly at least, almost everything having a bearing on patents and inventions, including interference practice in the U. S. Patent Office, infringement suits, the sale of patent rights, and so forth.

The author does not advise inventors to prepare and prosecute their own applications; nevertheless, the information goes so much into detail that the reader might readily assume that he had sufficient information to enable him to attend to patent business himself, or at least to supervise in detail the work being done by his attorney. It might be embarrassing, however, for anyone not familiar with patents to depend upon the information given, on matters of importance.

In several instances the phraseology used is not in accordance with the expressions habitually used by those familiar with patent matters. This might cause some confusion or misunderstanding (p. 22—"Foreign *use* was patented"; p. 73, "a *new* patent may be issued" upon a renewed application; p. 54, "accessory patents" instead of a specific, limited, or "improvement" patent; "entering" a patent application instead of filing; etc.).

In many instances, quotations are made from the Rules of Practice of the U. S. Patent Office. It is a well-known fact that the Rules of Practice as published by the government are difficult to understand if the reader is not familiar with patent matters. In this respect, the author has made little improvement on the original rules. For example, on page 104, a portion of rule 176 is repeated almost word for word. This would give the impression that a patent granted on a renewed application would carry the date of renewal as the filing date. As a matter of fact, the original filing date appears on the face of the patent.

In somewhat the same way, it is stated that a preliminary injunction may be granted upon proof of infringement. This is true, but it is practically never done unless the patent has been previously adjudicated (p. 136). And p. 166 states that "infringement is usually easy to detect and to prove," when referring to a product. Anyone who can do this can command an immense salary.

Probably most business men would immediately recognize that some of the advice offered is rather unusual and difficult to follow. Who would expect anyone but a lawyer to attempt to familiarize himself with the laws of the various *states* for the purpose of determining whether or not any of them refer to the assignment of patents, and if so, to what extent? (p. 122).

In general, a great deal of the advice offered here seems to be unnecessarily detailed for use by the non-professional reader and not sufficiently explained to avoid serious misunderstanding.

Coal-Tar Economics

DIE DEUTSCHE STEINKOHLENTEERINDUSTRIE UND IHRE WIRTSCHAFTLICHEN ZUSAMMENHÄNGE. By *F. A. Heydenreich.* Wilhelm Knapp, Halle (Saale), Germany, 1931. 256 pages. Price, 24 M.

Reviewed by HORACE C. PORTER

REPRESENTING Vol. 26 of the German series, Coal, Coke and Tar, edited by Dr. J. Gwosdz, this is a comprehensive treatment of the economics of the German tar industry. There are 256 pages with seven chapters and ten charts. Only the first chapter, 23 pages, is devoted to the technical side of the industry, without illustrations or descriptive detail. Some of the statements of the author in this connection will be questioned by many authorities; e.g., that tar arises from the resins and waxes of the coal and not from the cellulose constituents, and that tar, being formed first at 400 deg. C., is the first product of coal distillation, gas being produced first at 500-600 deg.

The remaining six chapters are economic and historical, tracing the development of the business of tar producing and tar distilling in Germany. The coking and gas-making industries are briefly described and emphasis is laid on the very much greater development of the former branch in recent years. Valuable statistical tables are given in this connection. Total tar production in 1929 was 1,700,000 tons; coke (100 per cent from by-product ovens) was 38,500,000 tons. Of the latter, only about one-third was used in blast furnaces; one-quarter was exported; and the remainder, 40 per cent, was consumed for general fuel purposes. Of the total coke, 92 per cent is made in the Ruhr district. Of the German "leucht-gas" production, 90 per cent is coal gas, 10 per cent water gas. Ammonia from coal distillation is no longer financially interesting to the gas works and some of them let it run to waste. Coal liquefaction, the author believes, will not in the future, even under most favorable market conditions, absorb more than 2-3 per cent of German coal production.

Chapter 4, consisting of 58 pages, is devoted to details

of the organization of the German tar industry. A valuable chart is given in this connection, showing graphically the structure of the industry, by classes, locations, and names of producing companies. The effects of the Versailles Treaty on the German industry are discussed in detail. Markets are described in Chapter 5, 60 pages, listing the various products and their uses, the extent of their manufacture, and probable future. Among these, particular interest attaches to sections on Bakelite, liquid fuels in relation to the world market, and hydrogenation in relation to the tar industry.

A valuable chapter, 16 pages, is devoted to the German foreign trade in tar products, and finally Chapter 7 discusses price development and analyzes value building in the tar products industry. Although the book is exclusively an account of the German situation, it will be of considerable interest both for its content and as a type of study, to American workers in the field.

Two Billion Years of Mankind

LAST AND FIRST MEN. By *W. Olaf Stapledon.* Jonathan Cape and Harrison Smith, New York City, 1931. 371 pages. Price, $2.50.

Reviewed by JAMES H. COLLINS

ONE MORNING, shortly after a summer dawn in the mountains of ancient Hindoo Kush, early walkers noticed an unaccountably greenish tinge in the sky. Presently this concentrated in a thousand tiny cloudlets. These cloudlets touched the mountain peaks, and began to slide down. A little later, they reached a village, which was blotted out, and the astonished inhabitants of Earth had the first warning of an invasion of colloidal droplet beings from Mars.

It all happened when our Earth was comparatively young, in the year A.D. 10,000,000-and-something, and the visitors from Mars, where the intense dry, cold, bright climate had evolved beings of colloidal form, capable of direction by a group intelligence, began a war to destruction with our posterity—the Second Race of Men.

The chemical engineer who relishes H. G. Wells and Jules Verne will find a complete account of that war in this book by a British writer who, with regard for current knowledge of chemistry, biology, psychology, geology, astronomy, and physics, has woven a romance in generous space and time.

Two billion years are allotted to mankind, and in that period there are eighteen races, of which our own is first. As conditions on our globe change, the different races evolve various physical forms and stages of intelligence ranging all the way from savages to supermen with enormous brains, and men that live thousands of years. Other planets are invaded and occupied, and men rise almost to gods—to fall back into barbarism.

Here is a book that "clicks" with late scientific knowledge and theory, and is well within the realms of possibility, from our present viewpoints. About one-fourth of the story is devoted to an account of our own First Race, which passes through various historic phases after the World War, achieves an Americanized planet, and falls into eclipse about A.D. 6,700, to furnish the seeds of a second race, and so on.

Previous scientific romancers have been able to animate their stories with human characters, moved by individual passions. But in a two-billion-year scheme, with gaps of millions of years, this was impossible. On that account, the book is rather stiff reading for the fiction lover. But to technical men who have a grasp of theory in their own field and an acquaintance with recent advances in related fields this will be no obstacle. Personally, I found the reading of this clever book a fine mental exercise, and finished it with a detachment toward the problems of the present human race, in its 1931 predicament, which was as tonic as a vacation in the desert.

Properties of Electrolytes

THE CONDUCTIVITY OF SOLUTIONS and the Modern Dissociation Theory. By *Cecil W. Davies.* New York, John Wiley & Sons, Inc., 1930. VIII, + 204 pp.

Reviewed by BLAIR SAXTON

AS indicated by the complete title, this book attempts to give an interpretation of conductivity measurements in terms of the newer inter-ionic attraction theory developed by Debye and by Onsager. This is a very commendable undertaking when one considers that most of the treatment of the subject available in book form is of the older type. This book is divided into three parts: Introduction, Methods and Results, and Some Applications and Consequences.

In the Introduction there are two chapters: The Growth of the Ionic Dissociation Theory, and The Theory of Inter-ionic Attraction. Briefly it is a condensed treatment of the old and the new method of interpretation. Such brevity is satisfactory in the first chapter, but it is doubtful if the reader who has not attempted to follow the newer developments will be satisfied with the second. Admitting that a complete exposition of the Onsager theory is not within the scope of this book, still it seems to the reviewer that the author might have adhered to the usage of Lewis in defining the "practical" activity coefficient and of Debye and Hückel and others in defining the "rational" activity coefficient.

In Part II there are ten chapters: Experimental Methods, Solvent Correction, Conductivity of Very Dilute Solutions, Determination of Λ_o, Degree of Dissociation of Weak Electrolytes, Conductivity and Viscosity, Conductivity in Moderately Concentrated Solutions, Complete Conductivity Curve, Concentration and Temperature, Deviations from Ohms Law, and Conductivities in Mixed Solvents. The apparatus described is very simple and, while the reviewer does not believe in the use of ultra-elaborate apparatus unless absolutely necessary, still he does not think it is justifiable to dispose of the very useful recent improvements in bridge design with only a literature reference. It is gratifying to note that the author has given concentration errors the emphasis they deserve and seldom receive. The sections on the solvent correction, dilute solutions, and weak electrolytes are very well done. In dealing with the latter two topics, Onsager's equation is used to correct for electrostatic forces, and deviations from the equation are ascribed to incomplete dissociation. In this way reasonably good thermodynamic dissociation constants are obtained. This is perhaps the most important development in the newer method of treatment, or at least it has given the most convincing and satisfactory results. The conductivity method is especially applicable to the problem of determining thermodynamic properties of solutions of moderately strong electrolytes.

In Part III the topics treated are: The Application of Conductivity Theory to Analysis, The Dissociation of

Ternary Electrolytes, The Nature of Acids and Bases, Solvolysis, Complex Ions, Amphoteric Electrolytes, The Mobility of Ions, and The Degree of Dissociation of Electrolytes. Here Brönsted's theory of acids and bases and Bjerrum's theory of amphoteric electrolytes are given brief but clear exposition.

The book is clearly written and should prove valuable to the general reader in chemistry who wishes to keep abreast of present developments in this field. It should be read especially by physical chemists who are wedded to the older method of interpretation of the data. Even the specialist in this field will find it valuable.

Invention as a Human Product

THE PSYCHOLOGY OF THE INVENTOR. By *Joseph Rossman*. Inventors Publishing Company, Washington, D. C., 1931. 252 pages. Price, $3.

Reviewed by R. F. HATCH

FROM two points of view the work is interesting: First, in its many odd facts about inventions and inventors and patents; and second, in the psychological aspect of inventors. Anyone who reads it with the idea that it will teach him to become an inventor and to get rich quick, will be sadly disappointed. In order to obtain the value of this work, it must be read carefully by people of sufficient intelligence and education to understand and profit by what they read.

Dr. Rossman went to what is, without doubt, the best source of information on inventors and inventions. He sent out questionnaires to over 700 inventors, 500 patent attorneys, and 300 directors of research and development departments of corporations. The average number of patents granted to each inventor was 39.3 and some of them had over 1,000 to their credit. The selected inventors thus include the most prolific and successful ones in the United States, and their opinions are certainly worthy of careful consideration.

There are 18 tables in the book made up from the replies to the questionnaires, and from these the reader can learn facts both humorous and useful. For instance, the fact that practically all successful inventors are married might lead one to assume that the first step toward success is matrimony. On the other hand, the general conclusion is that success presupposes not only a certain amount of natural aptitude, but also hard work extended over a considerable period. The chance inventions by which the inventor becomes rich overnight are extremely rare.

Interesting statistics are provided on the number of interferences before the Patent Office and the percentage of applications which never result in patents. A rather severe attack is made on the United States patent system, and there is no doubt that it results in many cases of hardship and injustice. It is hard to imagine a system which would not be severely criticised by many inventors, and Dr. Rossman does not propose any definite changes.

Recent Textbooks

CHEMISTRY FOR STUDENTS OF AGRICULTURE AND HOME ECONOMICS. By *Robin Charles Burrell*. McGraw-Hill Book Co., Inc., 1931. 459 pages. Price, $3.50—Even its long title does not suggest the full scope of the author's accomplishment, for in combining the elements of chemistry with their numerous manifestations in all phases of life, he presents the subject with a sobriety that is more informative than any number of "baby talks" to laymen.

INTRODUCTORY COLLEGE CHEMISTRY. By *Harry N. Holmes*. Second edition. The Macmillan Co., New York City, 1931. 550 pages. Price, $3.25—Designed primarily for college students, this text has been revised to include information on the new developments in hydrogenation, nitrogen fixation, and organic technology. Industry is rather heavily emphasized.

QUALITATIVE CHEMICAL ANALYSIS. By *Louis J. Curtman*. The Macmillan Co., New York City, 1931. 539 pages. Price, $4—A very complete volume, which, although designed for college use, may be helpful to the plant man when questions arise. The text is very complete and well equipped.

QUANTITATIVE CHEMICAL ANALYSIS. Seventh Edition. By *Henry T. Talbot*. The Macmillan Co., New York City, 1931. 250 pages. Price, $2.50—Another revision growing out of the author's accumulated experience.

PRINCIPLES OF ORGANIC CHEMISTRY. Third Edition. By *James F. Norris*. McGraw-Hill Book Co., Inc., New York City, 1931. 595 pages. Price, $3—Like other recent revisions, this one has emphasized industrial processes in bringing its usefulness up to date.

QUALITATIVE CHEMICAL ANALYSIS. By *Herman T. Briscoe*. D. Van Nostrand Co., Inc., New York City, 1931. 279 pages. Price, $2.25—A distinguishing feature of this book is that a long explanatory text precedes any of the actual routine methods of analysis. It has the advantage of showing the student why he is doing the work before he does it.

SMITH'S INTRODUCTORY COLLEGE CHEMISTRY. By *James Kendall*. The Century Co., New York City, 1931. 555 pages.—Another byproduct of Kendall's masterful edition of Alexander Smith's more comprehensive work.

Other New Arrivals

THE AUTOBIOGRAPHY OF AN ENGINEER. By *William LeRoy Emmet*. Fort Orange Press, Albany, N. Y., 1931. 213 pages.—The modest personal story of an engineer looking back over 72 years is the second "human" narrative drawn from the annals of General Electric. Dr. Emmet recounts his training in the Navy, his entrance into early electric-railway history, and then his several larger achievements at Schenectady, ending with the mercury-vapor boiler lately installed at Hartford. The absence of literary elegance is scarcely to be regretted; if only other septuagenarian engineers would record their personal histories, their ripe outlook and invaluable store of impressions would need no pretentious cloak. What an autobiography Dow might have written, or Hendrick!

RADIOELEMENTS AND ISOTOPES: CHEMICAL FORCES AND OPTICAL PROPERTIES OF SUBSTANCES. By *Kasimir Fajans*. McGraw-Hill Book Co., New York City, 1931. 125 pages. Price, $2.50.—The ninth of the George Fisher Baker lectureships at Cornell University, delivered early in 1930, was the source of this volume.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, TRANSACTIONS, Vol. XXV, 1930. D. Van Nostrand Co., Inc., New York City, 1931. 262 pages—Contains papers read at New Orleans last December, already reported in part in *Chem. & Met.*

MINERAL RESOURCES OF THE UNITED STATES, 1928. Part 1, Metals; Part 2, Non-Metals. Edited by *Frank J. Katz*. U. S. Bureau of Mines, Washington, 1931. 910 and 801 pages. Price, $1.50 and $1.25—These books aggregate the various separately issued bulletins and reports.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY PAPERS, 14th Series. Published by the Association, New York, 1931. 434 pages. Price, $5—Contains the proceedings of the annual meeting in February, reports, technical papers, proceedings of the Erie (Pa.) meeting last September, and a complete bibliography.

SELECTIONS FROM RECENT LITERATURE

HEAT EXCHANGE CALCULATIONS. H. Hausen. *Zeitschrift für angewandte Mathematik und Mechanik*, April; pp. 105-14. In heat exchangers of the regenerative type, in which a thermal storage system is traversed alternately by hot and cold gas, at least two units are necessary for continuous operation. Thermal calculations for this type of apparatus were formerly made by considering the alternate rise and fall of temperature to be a series of temperature vibrations, and then breaking up this series into its components. An integration method followed, which made the calculations much less tedious; and now the integration method has been itself made easier by the aid of a graphic method. Considered separately, the graphic method is based on the differential equations of the regeneration process, by transition from the differentials to finite differences. In the integration, or "heat-pole," method, an integral is derived from finite influences by summation, the finite influences being derived from the "heat poles," which must be defined for the purposes of the calculation. Thus the "heat-pole" method is an approximate solution of an integral equation, and can be used to trace the temperature course from the beginning of each regeneration. For numerical calculations, when approximations are acceptable, the quickest results are obtainable by a combination of the integration and the graphic method.

ACIDPROOFING CHIMNEYS. B. Schütz. *Chemiker-Zeitung*, May 20; p. 384. Hot flue gases are generally not corrosive to masonry chimneys, except perhaps near the top, where rain water may provide moisture for acid attack. But in stacks where there is a large cooling effect before the flue gases escape, condensation may occur and acid attack becomes a hazard which requires attention. Water glass, as such, is not a suitable protective cement, because it tends to harden from the outside in, leaving the inner layers for a long time subject to leaching out by the acid moisture. To meet this difficulty, a silicate cement has been developed in Germany, in which the setting is chemically accelerated so that the cement sets uniformly throughout its mass after it is applied to the chimney. Small stacks can be built entirely of acidproof brick, cemented with this cement; but for large stacks, strength and cost considerations do not admit of such construction. It is then preferable to build a stack of suitable construction—e. g., concrete—and line it with acidproof material, cemented with the new silicate cement. Areas of localized attack can be protected with the new cement; and it is also useful for repairing chimneys which have already been exposed to acid attack. For this use, damaged portions must be scraped deep enough below the corroded material so that the protection will be effective when applied. The cement is not suitable for use alone; it serves best as a cementing medium for acidproof brick or the like. If used alone, it should be applied in several coats, to a total thickness of at least 2 or 3 cm. (about an inch).

CORROSION OF BURIED STEEL. F. L. Bassett. *Journal of the Society of Chemical Industry*, May 8; pp. 161-6T. In a study of soil corrosion of water lines and oil lines through a desert region having widely different soils, it was found that active corrosion occurred in ground that was neither acid nor salty. Steel pipe corroded rapidly in many places; even so-called rustless steels failed. It has been generally believed that rapid corrosion occurs in salty soils, but not otherwise. Laboratory tests made in this investigation tend to indicate that deeper burial in well compacted, salty ground would give the best protection. With shallow burial, temperature fluctuations and the differences in water equilibrium in the surface soil have an active influence on corrosion. The tests also indicate that, in so far as salt concentration is a factor, maximum corrosion is found in soils containing about 0.2 per cent of salt. At higher concentrations, the water retentivity of the soil is increased, so that oxygen diffusion through the soil is retarded and corrosion begins to decrease. Chlorides greatly accelerate the anodic type of corrosion, the assigned reason being the penetrative power of the chloride ion, which enables it to pierce the protective film around the anodic points. The tests were made in artificial soils, in which water retentivity, hygroscopicity, moisture content, chloride content, and other properties were varied so as to give controlled test conditions. Among unsalted soils, least corrosion was observed in those having a close, dense texture which prevented oxygen diffusion.

FERMENTATION EQUIPMENT. J. Schäfer. *Zeitschrift des Vereins deutscher Ingenieure*, May 9; pp. 592-4. The Nathan process for carrying out fermentation reactions follows usual practice in the preparation of the mash and the wort, but differs from other processes in that the fermentation is effected in a thoroughly sterilized closed system. This sterile procedure is particularly adapted to tropical conditions. An installation of the Nathan process in Surabaya is described, and illustrated with diagrams of apparatus and curve charts of evaporator performance. From the equipment standpoint, the most noteworthy advances are found in the fermentation vats, the malt grist mills and the evaporation and condensation apparatus. Since the process involves the access of variable amounts of air to the surface of the boiling wort, the vapor coming from the evaporator pans is a steam-air mixture carrying a relatively high percentage of air. Hence the calculation of condensation surface is important from the standpoint of operating costs. In the apparatus used at Surabaya, the total condenser surface comprises steam-condensing, air-cooling, and condensate cooling surfaces. Careful calculations have been made of the influence of air content in the effluent vapor on heat transition for various cooling water velocities, so that the amount of surface required for each cooling operation can be ascertained for a condenser of any given capacity. Curve charts show the relations of temperature, amount of cooling surface, and rate of heat transfer.

MEASURING OXIDATION RATE. J. Jany. *Zeitschrift für angewandte Chemie*, May 9; pp. 348-51. Progress in the utilization of drying oils, with particular reference to selecting the oils and adapting them to the intended use, has been much hampered by the difficulty of accurate evaluation. The principal problem in ascertaining the service behavior of the drying oils is to measure accurately the rate of oxidation under various conditions. No suitable instrument has been available for measuring such slow rates of oxidation over short-time intervals; it has been customary to measure the amount of oxygen absorption occurring in a period of several hours. As an autocatalytic process, oxidation of drying oils varies a great deal with time, and so it is important to be able to measure the very small oxygen absorption occurring in a short time interval; e. g., 10 or 15 min. The Barcroft blood gas manometer has now been successfully adapted to this purpose, so that a convenient and precise method is now available for measuring the oxidizability of oils. The new method is particularly helpful in technical work, because it is now possible to measure accurately the influence of extraneous factors on the rate of oxidation, to test positive and negative catalysts for their efficacy, and in general, to obtain reliable information of the behavior of the oils under a given set of conditions. Measurements are reported on linseed, rapeseed, whale, and mineral oils, and on oleic acid and turpentine.

ELECTRODIALYSIS. L. Reiner. *Journal of Physical Chemistry*, February; pp. 423-4. On account of the increasing use of electrodialysis as a laboratory method, an improved electrodialyzer has been designed in the research laboratories of Burroughs, Wellcome & Co. at Tuckahoe, N. Y. In previous practice, dialyzers were put together from

three pieces corresponding to the three chambers commonly used in electrodialyzers. But this is tedious, and requires use of rubber washers and of clamping devices to hold the parts together. In the new apparatus, two medium-porosity Jena glass filter plates are sealed in a glass cylinder at a suitable distance apart for forming the middle cell. These filter plates serve as membrane supports. The middle cell has an opening for a stirrer; it appears that stirring is not required in the outer cells, because the water can be circulated fast enough to give the necessary effect. The two ends of the cylinder are closed with rubber stoppers, which carry the electrodes and the inlets and outlets for circulating water. The anode may be platinum gauze or platinized glass; the cathode may be copper or nickel gauze. The membranes may be ether-alcohol collodion or acetic acid collodion; both should preferably be coated at the same time, by filling the whole apparatus with collodion and pouring it off only when the first drops of solute appear on the back sides of the filter plates. After draining, the apparatus is put in water for five minutes; the collodion is then scraped from the glass wall.

MAGNETIC SUSCEPTIBILITY. James F. Spencer. *Journal of the Society of Chemical Industry*, Jan. 30; pp. 37-41T. Magnetic susceptibility is the most additive of the physical properties of the elements; the susceptibility of a compound can therefore be calculated from those of its constituent atoms. One of the first chemical applications was the use of magnetic susceptibility data as a relatively easy means of ascertaining how much success was being attained in the separation of the rare earth metals or their compounds. In metallurgy, magnetic susceptibility may be utilized to detect the formation of intermetallic compounds in alloys; for example, the silver-lead system is remarkable for the fact that these two metals, in a certain composition range, form paramagnetic alloys, the maximum paramagnetism being more than 20 times as strong as the diamagnetism of either pure silver or pure lead. The magnetic properties of oxygen are particularly interesting, both with respect to the theoretical and the practical problems of this gas in its relation with air and other gases. As a potential but as yet undeveloped field of application of magnetic susceptibility measurements, there is the possibility of using them to ascertain the velocity of chemical reactions. This would have the particular advantage that the measurement could be made without stopping the reaction, withdrawing a sample, or interfering with the reaction in any way. Another potential use is in the study of the effect of mixing organic liquids; for example, for ascertaining whether or not a molecular compound is formed.

AIR CONDITIONING IN PAPER MILLS. Fritz Hoyer. *Papier-Fabrikant*, May 10; pp.377-80. The hygroscopic nature of paper is a serious disadvantage for certain uses, particularly in the graphic arts. Much of the difficulty is due to the fact that machine-made paper shows different behavior in the lengthwise and transverse directions; and these differences are intensified by fluctuations in the moisture content of the paper. Much of the trouble due to hygroscopicity can be overcome by proper control of the atmospheric humidity during the manufacture of the paper web. An air-conditioning installation for this purpose must conform to strict standards of uniformity, must be easy to operate, and must not permit mist formation or fogging in the humidified air. The Wiessner air-conditioning apparatus has been developed in Germany particularly to meet the requirements of paper manufacture. It has an electrically driven centrifugal ventilator, utilizing either fresh air, or air returned from the circulating system, or a mixture of both, the mixing ratio being controlled by an automatic device. The conditioning apparatus warms or cools this air to the prescribed temperature, and dries or moistens it to the prescribed degree of humidity, the water spray for humidification being supplied from a centrifugal pump. Steam for heat and water for humidification are fed through combined spray nozzles which can receive both water and steam at the same time. The average power consumption for moving air and water and operating the control devices is 6 hp., and the average steam consumption is about 100 kg. per hour when the outside temperature is 40 deg. C. lower than the normal room temperature.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Reproduction on Pulpwood Lands in Northeast, by Marinus Westveld. Department of Agriculture Technical Bulletin 223; 20 cents.

Latin American Markets for Soaps and Soap Ingredients, by E. L. Thomas. Bureau of Foreign and Domestic Commerce Trade Promotion Series 121; 15 cents.

Factors Governing the Entry of Solutions Into Ores During Leaching, by John D. Sullivan and E. O. Ostrea. Bureau of Mines Technical Paper 498; 10 cents. Part II of this study.

Quicksilver, by C. N. Schuette. Bureau of Mines Bulletin 335; 45 cents.

Petroleum Refinery Statistics, 1929, by G. R. Hopkins, Bureau of Mines Bulletin 339; 30 cents.

Properties of California Crude Oils, by A. J. Kraemer. Bureau of Mines Report of Investigations 3074; mimeographed. Part IV of a study of these crude oils, giving additional analyses.

Petroleum Refineries in the United States, Jan. 1, 1931, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines Information Circular 6485; mimeographed.

Significance of Solvent Analysis as Applied to Coal, by E. B. Kester. Bureau of Mines Information Circular 6486; mimeographed.

Barite and Barium Products, by R. M. Santmyers. A revised edition of Bureau of Mines Information Circular 6223. Part II of this study, on barium products.

Magnesite, by Paul M. Tyler. Bureau of Mines Information Circular 6437; mimeographed.

Mineral Production Statistics for 1930—Preliminary mimeographed statements from the Bureau of Mines on: Lead and zinc pigments and zinc salts, fullers earth, mercury, manganese, copper, and metallic cadmium.

British Dyestuffs Production and Trade, 1930, by Roger R. Townsend. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 344; mimeographed.

Damage by Insect Pests in the United States, by J. A. Hyslop. U. S. Department of Agriculture Bureau of Entomology Document E-286; mimeographed. An estimate of the damage done by some of the more important insect pests.

Practical Method of Solving the Emergency Manganese Problem, by C. H. Herty, Jr. Bureau of Mines Report of Investigations 3107; mimeographed.

Filters for Reproduction of Sunlight and Daylight and Determination of Color Temperature, by Raymond Davis and K. S. Gibson. Bureau of Standards Miscellaneous Publication 114; 45 cents.

Accuracy of Manometry of Explosions, by C. M. Bouton and others. Bureau of Mines Technical Paper 496; 15 cents.

Compendium on Limes in Hydrometallurgy and Flotation, by R. G. O'Meara and others. Bureau of Mines Information Circular 6423; mimeographed.

Microscopic Determination of the Ore Minerals, by M. N. Short. U. S. Geological Survey Bulletin 825; 60 cents.

Miscellaneous Publications

Mining Laws of Canada. Canadian Department of Mines, Ottawa—Revised digest of legislation affecting mining, grouped by territories.

Spectrum Analyses in Mineralogy. By A. A. Fitch. Adam Hilger, Ltd., London, England. Price 1s., 11d. 52 pages—An introductory text is followed by a tabulation of minerals with bibliographic references.

Economic Handbook of the Soviet Union. American Russian Chamber of Commerce, New York. 1931. 151 pages. Price, $1.—Economic data concerning the U.S.S.R. up to October, 1930. Very comprehensive and equipped with two good maps.

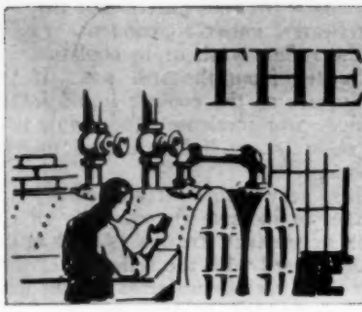
Publication List, Mellon Institute of Industrial Research. By Lois Heaton Pugsley—Fourth Supplement to Bulletin 2, Pittsburgh, Pa., 1931. 10 pages.

World Survey of the Zinc Industry. By W. R. Ingalls. Mining and Metallurgical Society of America, New York, 1931.—A general survey of economics and technology followed by individual geographic divisions.

Chemical Engineering and Chemical Catalog. Seventh Edition. Leonard Hill, Ltd., London, England, 1931.—Although different in arrangement of its individual parts, this English work is comparable to the American Chemical Catalog in all matters of content except perhaps in scope. In addition it has a small French-English lexicon.

Rubber Information. Leonard Hill, Ltd., London, England. 1931—A sort of rubber catalog including a dictionary of terms, list of ingredients and index to companies, but in view of the claim of "dealing with the industry in all its branches," it seems singular that practically all non-British firms have been omitted.

Amario de Estadistica Minera, Año de 1928. Depertemento de Minas, 1930. Talleras Graficos de la Nacion, Mexico. 462 pages—The seventh statistical analysis of Mexico's mining and mineral resources and developments.



THE PLANT NOTEBOOK

Sight Feed for Centralizing Control Of Distillation Equipment

By D. F. Othmer
Consulting Chemical Engineer
Rochester, N. Y.

IN THE DESIGN of distillation operations and the buildings to accommodate such systems, particularly when they are continuous, it usually is desirable to bring together at one operating level or station the various pressure, temperature, and flow-registering instruments and controls. The floor above the still pot or heating section usually is a convenient place to assemble the operating gages and control valves, but it is often 50 ft. or more below the overhead feeding tanks and valves regulating the supply of liquids to the columns. Various float devices have been used, employing levers, strings, and chains to indicate the level in the sight-feed box at the operating station; but, besides being cumbersome, these are subject to inaccuracies, and another system employing the familiar distant-reading manometer has been devised.

Accompanying drawings illustrate an arrangement using a simple sight-feed box which has a somewhat greater height than usual and which is located at any convenient point near the overhead feeding tanks. An inverted siphon or loop in the line from the feeding tank down to the lower level and back to the sight box allows the valve controlling the rate of feed to be placed at any desired lower level (see Fig. 1). An auxiliary valve to bypass this loop is placed at the upper level. If more convenient, the loop may be eliminated and a long extension, attached to the valve handle on the upper level, may be carried down through the intermediate floor levels.

The sight box has an orifice in the bottom and the rate of flow is indicated by the height of the liquid in the glass above this orifice. The hydrostatic pressure of this column of liquid is indicated at the operating level on a manometer of the Pneumercator, Telegage, or other similar type using a connecting air tube to transmit and balance the pressure. A small tube has an outlet just below the orifice level in the sight box and is connected to the manometer below, which contains a suitable liquid. Air is introduced into this balance tube either by means of a small auxiliary hand pump or from a compressed-air line until the pressure in the tube indicated on the manometer balances the pressure in the sight box above. Any air supplied in addition to that necessary to equalize the pressure escapes by bubbling through the liquid in the sight box without affecting the reading shown on the manometer. A reading may be taken almost instantaneously; but if a continuous indication or recording is desired, a small quantity of air is continually allowed to enter the balancing tube and bubble through the liquid in the sight box.

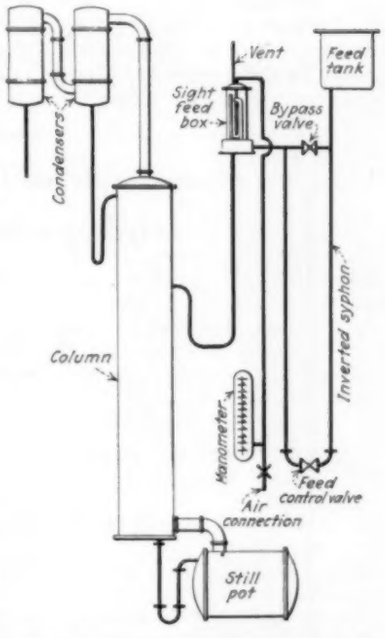


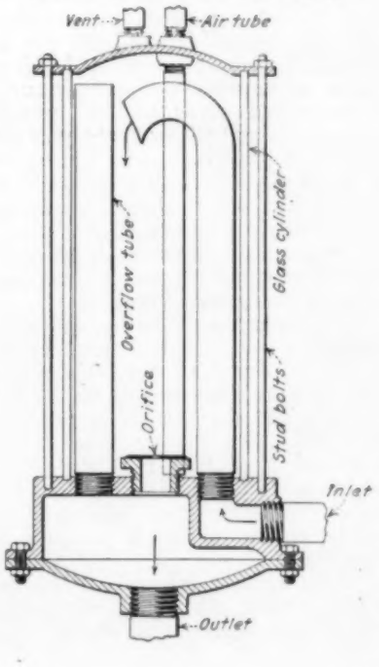
Fig. 1—Piping Diagram of Distillation Equipment and Apparatus for Feed Flow Control

The manometer (or level recorder if a continuous chart showing amount of feed is desired) is placed within easy sight of the control valve on the operating floor.

Illustrated in Fig. 2 is the sight box, which is similar in arrangement to the familiar measuring cylinders on gasoline pumps. It is shown considerably shortened in the drawings. The Pyrex glass cylinder may be of any convenient diameter and length: 6 in. in diameter by 18 or 24 in. in height is a suitable size. The glass is held between upper and lower plates with recessed gaskets by means of long stud bolts around the outside. The top and bottom plates are shown as bronze or brass castings in the figure but have been also designed using ½-in. rolled plates to which are brazed pipe fittings. The bottom of the chamber is the upper face of a pan-shaped casting. It has a central hole drilled and tapped 1¼ in. I.P.S. and two holes of 1 in. I.P.S., which are not necessarily on one diameter as shown. The hole on the right of the drawing is for the entrance of the liquid feed and is drilled or cored to come through a lug in the casting.

Liquid is brought up in the glass-walled chamber and discharged from the curved end of the feed tube in a visible

Fig. 2—Detail of Sight-Feed Box for Remote Indication of Flow Rate



stream. A brass bushing having a drilled axial hole is covered by a thin orifice plate soldered across the top. Several of these orifice plugs prepared with different sized orifices permit changing the quantity of feed which may be passed and accurately measured. The orifice discharge passes to the chamber beneath, which is vented through the pipe screwed in the hole at the left of the drawing. This pipe extends nearly to the top of the glass chamber and is large enough to accommodate any surge of liquid too large to be passed and measured by the orifice.

A bottom plate completing the lower assembly has a single central outlet for connecting to the pipe conducting the feed to the distillation system. The cover plate has two tapped openings, ¼ in. I.P.S., shown behind the plane of the cross-section. One acts as a vent and the other serves as an inlet for the small air tube connected to the manometer. This tube terminates below the orifice level and in the drawing is indicated behind the orifice plug.

The piping diagram of Fig. 1 shows a cold feed into the side of the distilling column. The measuring arrangement is the same if the feed passes first through a preheater, either to condense vapors for the reflux wash or to cool the slop discharged from the still pot. If the feed passes as the cooling liquid in the dephlegmator condenser, the supply tank and sight box will be elevated to correspond.

This very same arrangement may be used to indicate the quantity of the reflux or product streams as well as the feed. If used with the reflux, the valve controlling cooling water to the dephlegmator is located at the operating level near the indicating manometer.

Calibrating Thermocouples For Low Temperatures

By A. J. Monack

Department of Ceramic Engineering
University of Illinois
Urbana, Ill.

MERCURY-IN-GLASS thermometers are not suitable for exceptionally accurate work unless they are calibrated with care and unless proper corrections (such as for emergent stem) are made. In addition, they are rather bulky instruments for some types of work and their fragility is a disadvantage. Thermocouples of Chromel-constantan or copper-constantan may be used to measure with precision temperatures up to 360 deg. C. Such thermocouples, once they are calibrated, may be used for a considerable length of time before another calibration is necessary. The following method of calibration will be found satisfactory from the viewpoints of simplicity and of accuracy.

The melting point of ice (ice and water in contact) gives the zero point. The transition temperature at which $Na_2SO_4 \cdot 10\ H_2O$ changes to Na_2SO_4 is 32.38 deg. C. A constant-boiling mixture of benzene and methyl alcohol (60 per cent C_6H_6 and 40 per cent CH_3OH) gives a point at 58.35 deg. while a constant-boiling mixture of benzene and acetic acid (2 per cent CH_3COOH and 98 per cent C_6H_6) gives a point at 80.05 deg. The boiling point of water gives the fifth point at 100 deg. The boiling points given here apply to a barometric pressure of 760 mm. If the atmospheric pressure is greater or less than standard, the boiling points must be corrected accordingly.

The thermocouple to be calibrated is placed in a thin-walled tube closed at one end. For the ice point the couple and tube are immersed in the ice-water mixture and the emf. of the couple is recorded. For the transition temperature of $Na_2SO_4 \cdot 10\ H_2O$ the thermocouple and tube are immersed in a test tube containing the sulphate. The whole is then placed in a water bath and heated slowly. Readings are taken at short regular intervals. The curve which results when millivolt readings are plotted against time shows a horizontal portion which corresponds to the transition temperature.

It is best to repeat this process with falling temperatures and plot another curve. The mean emf. of the two horizontal parts of the curves is taken as the transition temperature. The boiling points are best obtained by the use of a Cottrell boiling-point apparatus, which is used in physical chemistry for determining the elevation of the boiling point caused by dissolved substances. The proportions of the liquids in the constant boiling mixtures need not be exact, since the one in excess will volatilize until the constant-boiling mixture results.

For points at higher temperatures the following may be used:

	Boiling Point, deg. C.
52 per cent amyl alcohol, and 48 per cent amyl iodide....	127.3
19 per cent butyric acid, and 81 per cent brombenzene....	147.5
31.82 per cent water and 68.18 per cent nitric acid.....	121.7

The boiling points of the constant-boiling mixtures are not as much affected by small amounts of impurities as are those of the pure substance.

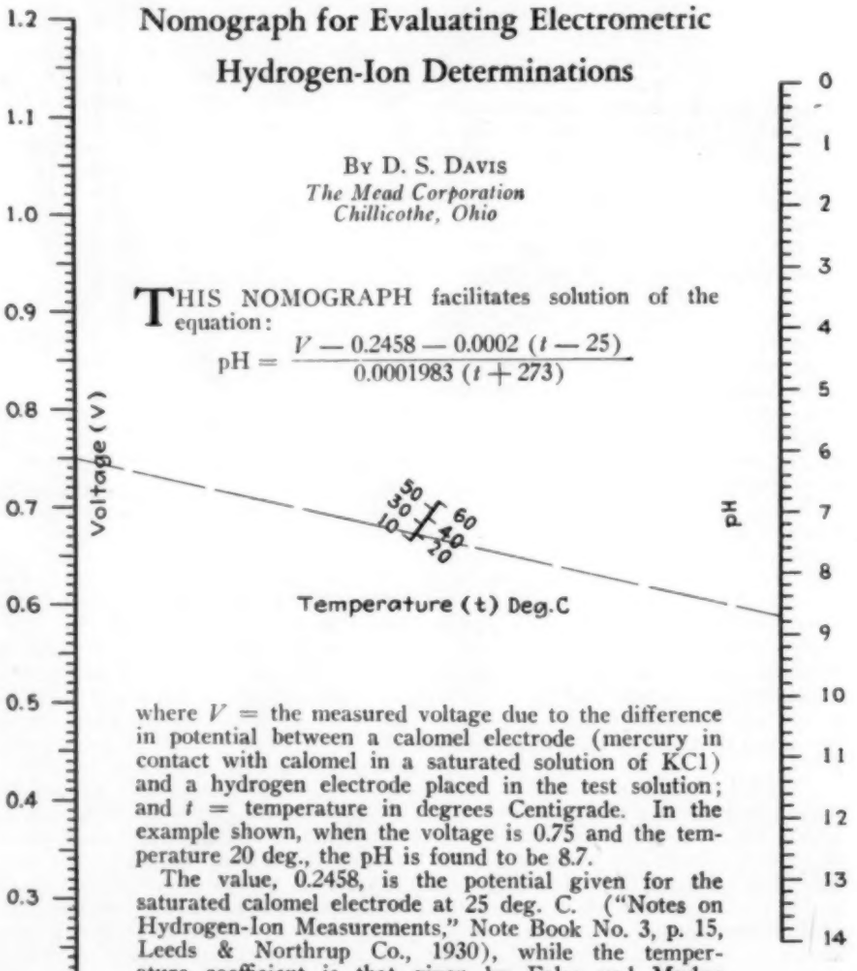
Nomograph for Evaluating Electrometric Hydrogen-Ion Determinations

By D. S. Davis

The Mead Corporation
Chillicothe, Ohio

THIS NOMOGRAPH facilitates solution of the equation:

$$pH = \frac{V - 0.2458 - 0.0002\ (t - 25)}{0.0001983\ (t + 273)}$$



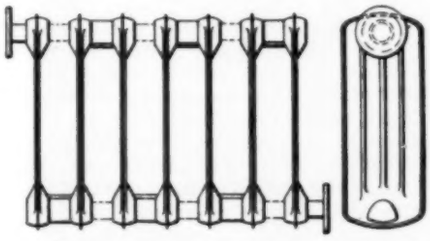
where V = the measured voltage due to the difference in potential between a calomel electrode (mercury in contact with calomel in a saturated solution of KCl) and a hydrogen electrode placed in the test solution; and t = temperature in degrees Centigrade. In the example shown, when the voltage is 0.75 and the temperature 20 deg., the pH is found to be 8.7.

The value, 0.2458, is the potential given for the saturated calomel electrode at 25 deg. C. ("Notes on Hydrogen-Ion Measurements," Note Book No. 3, p. 15, Leeds & Northrup Co., 1930), while the temperature coefficient is that given by Fales and Mudge (*J. Am. Chem. Soc.*, **42**, 1920, p. 2434).

EQUIPMENT NEWS
FROM MAKER AND USER

Monel Metal Radiator

A RADICAL DEPARTURE in the fabrication of heating surface for industrial purposes has been announced by the Maschinenfabrik Wiesbaden G.m.b.H., Wiesbaden, Germany. This consists in the production of pressed sheet-metal sections which are welded together to form radiator sections similar in appearance to the ordinary cast-iron radiators used for building heating. The method has the advantage, over the use of tubes, according to the manufacturer, of greatly reducing cost, since the wall thickness can be considerably less than is required with tubes, and the price of sheet metal is generally much less, weight for weight, than tubes.



Pressed Monel Metal Radiator for Industrial Use

In the drawing above is shown one form in which the new radiator is made. The sections, it will be noted, are connected in series, although they may be connected in parallel, as is indicated by the dotted lines. In another form the short sections of tubing between radiators are eliminated, producing a more compact, close-coupled unit. Units may be connected to give any desired length of heating (or cooling) fluid travel, as well as any required amount of surface. They are extremely flexible in application and are said to be suitable for relatively high pressures. They may also be used for condensing purposes. They are made in thicknesses from 0.91 to 1.50 mm. and are recommended by the maker for all uses where Monel metal is satisfactory.

❖

New Air Conditioner

WASHING and conditioning of air are the functions of a new filtering and conditioning device recently placed on the market by B. F. Sturtevant Co., Hyde Park, Boston, Mass. This device, known as the Filticooler, is available in groups of one, two, or three units, and is therefore extremely flexible in capacity and application. It is said to require much less space than the usual types of air washer, and at the same time incorporates an air filter not generally found in washing equipment. A feature of the Filticooler is its very low air resistance, which is said to have been reduced to the absolute minimum. This resistance is the resultant of two eliminators, two air filters, and the action of a water spray against the air flow.

❖

Portable Cranes

SEVERAL MODELS of portable crane, both hand- and motor-operated, have been announced as a new line by the Lewis-Shepard Co., Watertown Station, Boston, Mass. The cranes are of four types, including hinged, telescopic, revolving hinged, and revolving telescopic. The drives are hand-worm, hand-spur, and electric-worm drive. Air motors and gasoline engines may be provided where conditions require power but prevent the use of electric motors. The floor and sheave wheels are equipped with roller bearings and moving parts are equipped for high-pressure lubrication. Heights range from 6 to 14 ft., and capacities from 500 to 2,000 lb.

❖

Water Trap

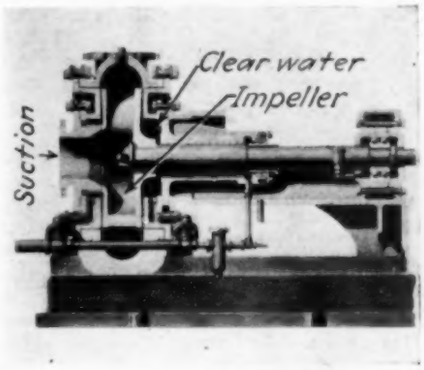
DIRT AND WATER may be trapped and settled out of lines carrying gasoline, turpentine, naphtha, benzol, and other solvent materials not miscible in water, through the use of a water trap recently developed by Aqua Systems, Inc., 2 Lafayette St., New York City. This device is known as the Aquatrap and consists of a horizontal steel cylinder which is connected in series with the line. The intake connection contains a float-operated valve which is normally in the open position. The float is of the differential type, floating in water but sinking in gasoline and other solvents lighter than water. Thus, when the quantity of water settled out has risen to a predetermined level, the float rises, closes the intake valve, and shuts off the flow of solvent. When this occurs, it is necessary only to drain the greater part of the water from the trap, whereupon the flow is automatically resumed. The device is suggested for use in paint, oil, and rubber plants, and for other process applications where the presence of unremoved water in solvents might seriously interfere with operation.

❖

Water-Sealed Pump

A CENTRIFUGAL PUMP originally developed by the Allen-Sherman-Hoff Co., 235 South 15th St., Philadelphia, Pa., for handling ash-laden water against heads up to 400 ft., is now being offered by the company for the pumping of all abrasive-laden liquids.

The accompanying cutaway view illustrates clearly wherein the Hydro-



seal pump differs from the conventional centrifugal design. There are two principal points of difference. First, it will be noted that there is a small clearance between the shrouds of the impeller and the casing. Clear water at low pressure is introduced into the space outside the impeller, flowing continuously through the clearance and thus preventing any abrasive material from backing up and coming in contact with the large radial bearing.

The second principal difference lies in the arrangement of bearings and gland. In the Hydroseal pump, a large radial bearing of the water-lubricated type is placed between the gland and the impeller, thus making possible abnormally high impeller speeds. In the usual pump, shaft bearings are outside the pump casing. The gland, however, is smaller than in ordinary pumps, as it is required to hold only the pressure of the clear water which is introduced between the gland and the radial bearing to serve as a lubricant and a secondary protection for the bearing.

This pump is obtainable in both vertical and horizontal models. It is constructed of a steel alloy said to be highly resistant to erosion. It is said to require very little attention and to involve only small expense for clear water.

New Cast Steels

THREE new alloy steels of lower test strength than its standard product, Nikeladium, have been announced by the Los Angeles Steel Casting Co., Ltd., 2444 S. Alameda St., Los Angeles, Calif. The new steels, known as Al 20, Al 30, and Al 40, have respectively tensile strengths of 60,000, 70,000, and 80,000 lb., as compared with 100,000 lb. for Nikeladium. The yield points are respectively 35,000, 42,000, and 48,000 lb., as compared with 60,000 lb. for Nikeladium. The new steels are said to be especially designed to present various combinations of strength and toughness to fit special conditions of service.

❖

Gas-Detecting Instruments

DETECTION of gas is possible with two types of instruments developed by Vulkan-Werke G.m.b.H., Gutersloh i.W., Germany, and recently introduced into the United States by the Industrial Apparatus & Instrument Co., 241 Springfield Ave., Newark, N. J. One of the instruments, made in several models for industrial, sanitary, gas-company, and mining uses, will also determine the concentration of a known gas in a mixture of the gas and air.

The device just referred to, known as the Vulkan gas indicator, Schwerin system, consists of a pair of aluminum chambers separated by a porous diaphragm. One chamber is connected to one leg of a manometer tube, the other leg of which is open to the atmosphere. After both chambers have been flushed out with air, and the apparatus has been allowed to come to the temperature of the atmosphere, the air in one chamber is sealed in by closing cocks, while the air in the second chamber is displaced with a sample of the gas under test. Immediately diffusion begins to take place between the two chambers, through the porous diaphragm, with the result that a difference in pressure is set up in the two chambers and indicated on the manometer. The degree of unbalance shown is a measure of the concentration of the gas in the sample.

Since an instrument of this type is more convenient where ready portability is not a factor, the company has developed the Vulkan instantaneous gas indicator, Callenberg system, which is small, self-contained, compact, and easily carried in the pocket. In this instrument a miniature electric lamp is caused to light or is extinguished with slight changes in pressure inside a porous cylinder. If the cylinder contains air and is suddenly moved into an atmosphere containing a gas of different specific gravity, the diffusion will raise or lower the pressure, depending on the specific gravity of the gas.

These instruments are said to be suitable for use with gases of all kinds, both flammable and non-flammable, provided only that the specific gravity differs from that of air.

❖

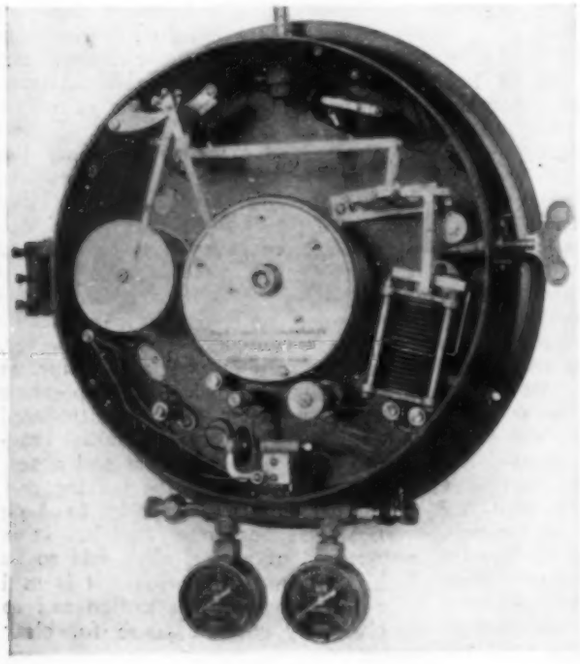
Stabilized Controller

ELIMINATION of "hunting" without wandering of the control point is said to be inherent in the new air-operated "Stabilog" automatic controller for temperature, pressure, or flow recently developed by the Foxboro Co., Foxboro, Mass. Operation of the controller is too complex for description here, but its accomplishments may be mentioned briefly.

In an ordinary throttling controller — i.e., one in which the control valve floats at a degree of opening just sufficient to maintain approximately the desired conditions—there is only one condition of demand which will cause the instrument to control exactly at any set control point. All other conditions of demand will result in the introduction of a greater or lesser degree of inaccuracy. This follows from the fact that the so-called throttling range —i.e., the amount of movement of the sensitive element required to move the control valve from full open to full closed—is stationary for any setting of the controller. In the new Foxboro instrument, the throttling range is caused to move with variations in demand, so that the control point remains constant for any instrument setting, regardless of changes in the demand.

In addition, the new instrument is said to suit the magnitude of the correction to the magnitude of the change in demand, quickly bringing about the correction without over-controlling. It is said to be capable of adjustment for any degree of lag in the process and to make control more accurate than has hitherto been obtainable. As is customary with this company's controllers, the Stabilog includes a recording feature.

Mechanism of New Stabilized Controller



❖

Corrosion-Resisting Pumps

RECENT developmental work has enabled the Westco Pump Corp., Davenport, Iowa, to modify its standard high-pressure, single-stage turbine pump for construction in a variety of corrosion-resisting metals including Stainless Steel, Monel metal, Ni-Resist metal, Ascoloy, Everdur, Illium, and special bronze. The standard pumps of this company are made of cast iron, steel, and commercial bronze.

This pump is of a unique type, consisting of a disk impeller supported on a through shaft which is carried on anti-friction bearings at both ends. Numerous radial vanes on both sides of the impeller, moving in an annular space within the casing, transport liquid from two suction openings at the periphery to two discharge openings, also at the periphery but separated from the suction by projections within the casing. Metal to metal contact is avoided, and the result is said to be a pump capable of producing high pressure at high efficiency, even in the smaller sizes. The pumps are of the double-suction, vertical-split-case type, capable of being taken down without disturbing the suction and discharge connections. Sizes range from ¾ in. suction and discharge to 5 in. suction and 4 in. discharge. Capacities range from 5 to 350 g.p.m. and heads to 300 ft. or more.

❖

Vertical Pressure Clarifier

FREE FILTERING materials and liquids containing small proportions of solids are filtered continuously under pressure by means of a new vertical-type leaf filter developed by T. Shriver & Co., Harrison, N. J. As appears from the accompanying drawing, the filter consists of a vertical casing equipped with a conical bottom in which a number of circular metal-cloth-covered filter elements rotate on a vertical shaft. Stationary scrapers, the angle of which can be adjusted from outside the casing, are placed between and in contact with the filter surfaces.

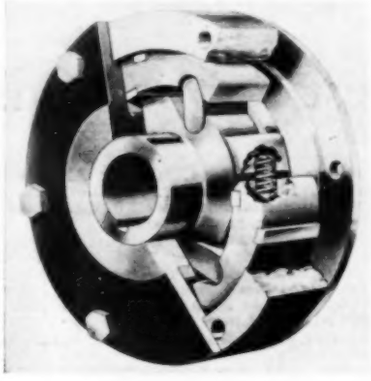
Material entering the lower portion of the tank passes upward, filters through the leaves, and discharges through the hollow shaft. Solids col-

lected on the fabric are scraped toward the outside, where they settle into a thickened sludge in the bottom of the container, from which they may be withdrawn either continuously or periodically.

❖

One-Way Clutch

POSITIVE unidirectional drive is furnished by the new Pitter One-Way Clutch, marketed by the Universal Gear Corp., 327 South LaSalle St., Chicago, Ill. The accompanying drawing shows the clutch to consist principally of a forged steel hub, a series of three steel shoes, an outer steel race, and two inner steel races. Relative



Pitter One-Way Clutch

motion of the hub and the races in one direction is possible because the shoes loosen. Reversal, however, immediately causes the shoes to lock between the inner and outer races. The purpose of the new clutch is to replace ratchets and non-reversing devices for conveyors and other equipment.

❖

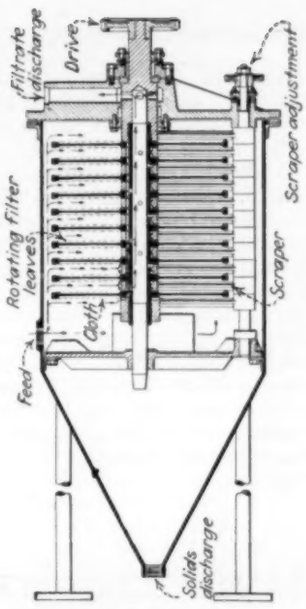
Explosion-Proof Switch

PUSHBUTTON control of motor starters in explosive, dusty, or corrosive atmospheres is said to be accomplished with safety by means of a new pushbutton recently announced by the Electric Controller & Mfg. Co., Cleveland, Ohio. The inclosing case is made of die-cast aluminum, the lower part of which is a tank which contains the oil-immersed contact. Because of the broad-flange construction, the switch may be used without oil if desired.

❖

Welded Steel Gear Blank

CUT GEARS may be made from a new line of all-welded, rolled-steel gear blanks manufactured by Lukenweld, Inc., Coatesville, Pa. The blanks consist of a disk to which are welded the hub, the rim, and a number of spokelike ribs. The manufacturer is prepared to supply blanks of very large size.



Continuous Vertical Pressure Clarifier

❖

Nickel-Clad Steel

NICKEL-CLAD steel plates of the type described in conjunction with the recent development of a nickel-lined tank car by the General American Tank Car Corp. (*Chem. & Met.*, page 104, February, 1931) have now been made available generally by the Lukens Steel Co., Coatesville, Pa. This material consists of a hot-rolled bimetal of pure nickel and steel in which the nickel, depending upon requirements, varies from 10 to 20 per cent of the total plate thickness. The product is available in all sizes of plate and in thicknesses of $\frac{1}{8}$ in. and heavier. It may be obtained through a large number of distributors in the United States and Canada.

❖

Cycle Controller

A RECENT development of The Bristol Co., Waterbury, Conn., is an air-operated cycle controller for controlling several operations in sequence. This instrument is made in two types, the first type using a single cam to operate four air valves, and the second type using separate cams mounted on the same shaft, operating the same number of air valves. The first type is used where the sequence of the several events which terminate the cycle is the reverse of their order at the beginning of the cycle. The second type is applicable where utmost flexibility is required. These controllers are adapted to be used in conjunction with either air-operated or electrical regulating devices for pressure, temperature, and so on, for starting and stopping various operations, as in the manufacture of rubber and resinoid articles, and in paper mills.

Homogeneous Metal Linings

VARIOUS METALS may be homogeneously bonded to steel, cast iron, brass, bronze, copper, and other metals by means of a new process recently designed by Francis R. Glenner, chemical engineer and general manager of the Homogeneous Equipment Co., 1569 Ocean Ave., Brooklyn, N. Y. The method is used for lining autoclaves, kettles, tanks, tubing, and other equipment with lead, tin, aluminum, bronze, copper, or nickel. The method is said to produce a molecular fusion which gives an inseparable bond, capable of withstanding vacuum, vibration, mechanical, and thermal shocks.

❖

Hard-Surfacing Materials

NEW hard-surfacing materials developed for its own use, and now being put on the market, have been announced by the American Manganese Steel Co., Chicago Heights, Ill. One of these is a rod containing from 13½ to 14 per cent of manganese. When deposited by electric-arc welding, this rod is said to produce toughness and wear resistance equal to manganese steel. It may be used for building up either manganese steel castings or other steels. A second material, known as Amsco 459 welding rod, is recommended as being highly resistant to abrasion, and is said to cost less than other hard-surfacing materials. This is a cast rod $\frac{1}{8}$ in. in diameter, suggested for use in surfacing pulverizer hammers and other parts subjected to severe wear.

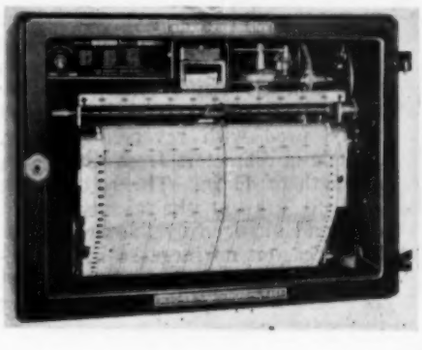
❖

Potentiometer Pyrometer

INDICATING, recording, and controlling models of a new potentiometer pyrometer have been announced by the Brown Instrument Co., Philadelphia, Pa. This instrument is a null type potentiometer in which any unbalanced condition operates through the mechanism to rebalance the potentiometer circuit and return the galvanometer to the zero position. This operation causes the indicating or recording mechanism to move to a new position corresponding with the new temperature.

At frequent intervals the galvanom-

New Potentiometer Pyrometer Recorder



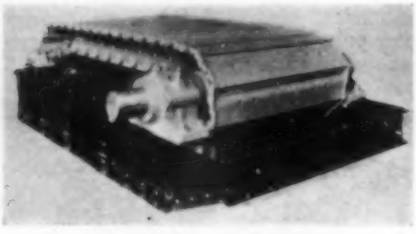
eter pointer is lightly clamped in position, whereupon a stepped device moves until it touches the pointer, the magnitude of its movement being dependent on the position of the pointer. Acting through a number of auxiliary levers, this moves the galvanometer slide wire to the new balance point, in one or more steps, and brings the pen or indicator pointer to its new position. As soon as the galvanometer pointer has returned to zero, the device is in balance and no further correction is made.

The instrument uses a strip chart 12 in. wide. It is compensated for humidity changes in the chart dimensions and includes among other features: complete inclosure of the galvanometer, protection of the slide wire by submersion in oil, and the use of corrosion-resisting construction materials. Where the instrument is to control, it is fitted with mercury switches capable of handling up to 50 amp. at 220 volts.

❖

Heavy-Duty Apron Feeder

HANDLING both abrasive and non-abrasive materials, in lump sizes from ¼ in. or smaller to 6 ft. in diameter, is the function of a new heavy-duty manganese steel apron feeder recently announced by the Link-Belt Co., 910 South Michigan Ave., Chicago, Ill. As appears from the illustration, this feeder is a new design consisting of



Heavy-Duty Apron Feeder

apron pans of cast manganese steel, from ⅜ to 1½ in. thick, depending on the service, supported on special chains which run over sprockets. The chains are of distinctive design and permit no sagging. They have no rollers themselves, but ride on rollers closely spaced on heavy through shafts attached to the frame.

❖

Improved Electrode

STAINWELD A is the designation of a new improved electrode for the arc welding of 18-8 chrome-nickel-iron alloys recently developed by the Lincoln Electric Co., Cleveland, Ohio. The new electrode is of the extruded type and is to be used with reversed polarity. It is made in diameters from 5/32 to ¼ in., in a length of 11 in. The rod coating is said to prevent the absorption of oxygen and nitrogen by the weld metal and to occasion no increase in its carbon content. It produces a weld of high strength and ductility, according to the manufacturer.

Waterless Gas Holder

CONSTRUCTION of the Klonne waterless, or piston, type gas holder, a European development, is being carried out in the United States by the Stacey Bros. Gas Construction Co., Cincinnati, Ohio. The Stacey-Klonne holder is cylindrical in form for its full height and has a cone roof surmounted by a turret. The interior is provided with a movable piston beneath which the gas is stored. The piston carries a flexible, expanding seal ring provided with lubricated packing which accommodates itself to the shell, forming, it is said, a perfectly tight seal. This eliminates the pumping, heating, and treating apparatus necessary to maintain a liquid seal.

Differential Limit Controller

SEVERAL different control functions may be served by means of a new differential limit controller recently developed by the Neilan Co., Ltd., 641 Santa Fe Ave., Los Angeles, Calif. This device consists of a mercury U-tube containing a float which rotates a disk carrying two adjustable limit points. These points may be set for any upper and lower differential limits to 100 in. of mercury. Movement of the limit points operates a pilot-valve snap switch, and this, in turn, controls the operating fluid. The device may be used to start pumps, motors, or other equipment, add or cut out make-up, connect in additional meters when limits are approached, and soon.

Manufacturers' Latest Publications

Chains. Newhall Chain Forge & Iron Co., 9 Park Place, New York City—Leaflet No. F 9110, illustrating sling hook and chain.

Chemicals. Merck & Co., Inc., Rahway, N. J.—117-page booklet on the company's line of laboratory chemicals.

Chemicals. Pfanstiehl Chemical Co., Waukegan, Ill.—Price list on various special chemicals including sugars and rare earths.

Ceramics. General Ceramics Co., 71 West 35th St., New York City—Leaflet introducing "Ceramit," a new dense ceramic material.

Compressors. Ingersoll-Rand Co., 11 Broadway, New York City—Attractive 44-page booklet, Bulletin No. 3132, describing the company's turbo blowers and turbo compressors.

Control. Shallcross Control System Co., Milwaukee, Wis.—Handy cumulative catalog describing control for a large variety of operations.

Conveying. Diamond Rubber Co., Inc., Akron, Ohio — Descriptive booklet called "Belt Practice" describing conveyor and elevator belts.

Distillation. Precision Scientific Company, 1736 North Springfield Ave., Chicago. —Bulletin 31B on laboratory type of water stills, and Bulletin 31C on automatic industrial water stills.

Drums. Pressed Steel Tank Co., Milwaukee, Wis. — Leaflet describing new Hackney corrosion-proof drums.

Grinding. Patterson Foundry & Machine Co., East Liverpool, Ohio—Catalog No. 312 with descriptions and specifications of pebble mills.

Heating. The Chas. Taylor Sons Co., Cincinnati, Ohio—Illustrated booklet on Sillimanite refractories as well as description of pyrometer protection tubes and glass house refractories.

Heating. Precision Scientific Company, 1736 North Springfield Ave., Chicago.—Bulletin 31A on heaters and hot plates.

Heat Technology. Hevi Duty Electric Co., Milwaukee, Wis.—Folders on pot-type electric furnaces and automatic excess temperature cutout.

Heat Treating. W. S. Rockwell Co., 50 Church St., New York City—Chart for steel heat-treatment with tables and constants on reverse side.

Heat Treating. H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa.—Bulletin No. 260 on "Falcon" continuous electric furnaces.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Illustrated folder introducing the Brown potentiometer pyrometer.

Instruments. The Foxboro Company, Foxboro, Mass.—Bulletin 169. An attractive and well-illustrated catalog on recording thermometers.

Instruments. The Meriam Co., 1955 West 112th St., Cleveland, Ohio—Bulletin No. 2 describing an improved pulsation shock absorber for pressure gages.

Insulation. Simplex Wire & Cable Co., 201 Devonshire St., Boston, Mass.—Reprint of an article by Charles R. Boggs on "Modern Progress in Rubber Compounding."

Metals and Alloys. Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J.—Pocket-size chart of Sweetalloy castings for corrosion and heat resistance.

Metals and Alloys. International Nickel Co., 67 Wall St., New York City—Booklet entitled "Pure Nickel for the Chemical and Food Industries" prepared on the basis of manufacture in Austria which has now become available here.

Metals and Alloys. Republic Steel Corp., Youngstown, Ohio — Publications are as follows: 132-page booklet on Agathon alloy steels; an educational booklet on sheet iron; and catalog on Toncan iron pipe, very attractively illustrated.

Metal Inspection. Claud S. Gordon Co., 708 West Madison St., Chicago—"Secrets of Metal," a leaflet describing the services of X-ray in testing metals and other materials.

Paper Technology. Dodge Manufacturing Corporation, Mishawaka, Ind.—Illustrated booklet entitled "Profitable Modernization for Paper Mills," showing various applications in the paper mill for Dodge-Timken bearings.

Power Generation. Edgemoor Iron Co., Edgemoor, Del.—Very attractive and informative, Catalog No. 69 describes bent tube types of water boilers.

Power Transmission. Cutler-Hammer, Inc., Milwaukee, Wis.—Booklet on magnetic clutches, entitled "Keeping Pace With Machine Design."

Power Transmission. W. A. Jones Foundry & Machine Co., 4401 Roosevelt Road, Chicago—Bulletin No. 51 describing and illustrating the company's Herringbone-Maag speed reducers.

Pumps. The De Laval Steam Turbine Co., Trenton, N. J.—Leaflet on pump installation in Pittsburgh, and catalog of clogless pumps.

Pumps. The Hayton Pump & Blower Co., Connersville, Ind.—Bulletin No. 160-E10 on open impeller-type multi-stage pumps.

Pumps. Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.—Folder illustrating several types of single-plunger pump made by this company.

Pumps. Worthington Pump & Machinery Co., Harrison, N. J.—Publications as follows: W-112-S12, W-112-S14, on piston pumps; D-412-S3, D-412-S2A on power pumps; and W-1319-S1, W-321-S1, W-312-S9, W-318-S8 on centrifugal pumps.

Refrigerants. Roessler & Hasslacher Chemical Co., 350 Fifth Ave., New York City—Service manual for the refrigerants Artic and methyl chloride.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—Booklet describing new M.S.A. hose mask.

Stoneware. General Ceramics Co., 71 West 35th St., New York City—Publications as follows: Booklet on various chemical apparatus, bulletin T on hydrogen sulphide generator, and bulletin T on improved suction filter.

Stoneware. The U. S. Stoneware Co., 50 Church St., New York.—Bulletin No. 402 on jars, tanks, stills and mixers for chemicals and foodstuffs.

NEWS *of the* INDUSTRY

Electrochemists Will Meet In Salt Lake City

MEMBERS of the Electrochemical Society will meet in Salt Lake City, Utah, Sept. 2-5 for the sixtieth convention of the society. The Hotel Utah will be headquarters for the four-day meeting. The program calls for addresses of welcome on Sept. 2 by George Dern, Governor of Utah, and Mayor Bowman of Salt Lake City. J. O. Elton, manager of the International Smelting Co. will speak on "Salt Lake City, a New Electrochemical Center." In the afternoon a scientific-technical session on "Cyanides in Metallurgy" will be conducted by M. R. Thompson, of the U. S. Bureau of Standards. The laboratories of the University of Utah also will be visited.

The morning session on Sept. 3 will be devoted to papers on electric furnaces and electrodeposition with Dr. Bradley Stoughton presiding. At noon there will be a round-table discussion on "Silver," under the chairmanship of Prof. J. A. Fulton, of the Mackay School of Mines. In the afternoon buses will leave the Hotel Utah for a trip to Mount Timpanogos, where winter sports may be pursued in mid-summer. In the evening the Acheson medal will be presented to Dr. Edward F. Northrup, of Trenton, N. J.

Sept. 4 will be devoted to visits to mining and smelting plants in the vicinity. A symposium on "The Physical Chemistry of Flotation" will bring the meeting to a close on Sept. 5. Prof. A. M. Gaudin, of the Montana School of Mines, will conduct the symposium.

In connection with the convention an all-expense vacation tour has been arranged. Under this arrangement member will meet in Chicago and leave that city on Aug. 26 for Yellowstone National Park. This will permit of a four and one-half days' tour of the park.

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Research Laboratories For Canada

THE National Research Laboratories at Ottawa, Ont., Canada, are nearing completion. The National Research Council was established by Parliament in 1916, for the purpose of developing scientific and industrial research and to promote the utilization of the natural resources of the country. Since then the N.R.C. has carried out its functions by utilizing to the fullest extent the existing laboratory facilities and the scientific man power available in Canada, especially in the universities and the technical divisions of the federal and provincial governments.

The Laboratories soon to be finished are intended to give adequate facilities for both scientific and industrial research, and will enable the N.R.C. to carry on effectively its important part in the promotion of the most profitable employment of the natural resources of the country and the development and expansion of its industries.

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European Scientists Will Attend Coal Conference

AN impressive group of scientists from Europe will take part in the Third International Conference on Bituminous Coal, which will be held at the Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16 to 21. Germany, England, and France will send the largest delegations.

Those interested in coal research may hear such German authorities as Dr. Friedrich Bergius, of Heidelberg, whose process for the hydrogenation of coal has been purchased by the I. G. Farbenindustrie; Prof. Franz Fischer, of the Kaiser-Wilhelm Institute for coal research, whose process for forming liquid hydrocarbons from gases has been widely discussed; and Prof. Ernst Berl, of Darmstadt.

Among the English scientists, contributions will be had from Prof. William A. Bone, of the Imperial College of Science and Technology, London; Dr. Cecil Lander, director of the Fuel Research Board, London, who has done much work on low-temperature carbonization and the utilization of coal generally; and Dr. R. Lessing, consulting chemist, also of London.

France will be represented by a distinguished group. Among them will be Profs. Mailhe and Camille Matignon, of the Sorbonne, Paris; and M. André Kling, director of the Municipal Laboratory of Paris, who has done outstanding work in producing motor spirits from coal by hydrogenation.

The tentative program outlined by the conference committee places emphasis on the economic side of the coal industry. A discussion of the competition between coal, petroleum, and natural gas will have an important place in the program.

Engineering Foundation Receives Gift

PRESIDENT John V. N. Dorr, of the United Engineering Trustees, Inc., and Chairman H. Hobart Porter, of The Engineering Foundation, announce that Ambrose Swasey, founder of The Engineering Foundation, has added $250,000 to his previous gifts, bringing their total to three-quarters of a million dollars.

Mr. Swasey made his gift at a dinner at the University Club, given by Chairman Porter of the foundation, at which Mr. Swasey was the guest of honor. There were present also more than thirty presidents and former presidents of national engineering societies, of the United Engineering Trustees, and of The Engineering Foundation, and other nationally prominent engineers.

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Chromium-Plating Patents In Dispute

PATENT infringement suit has been filed in the U. S. District Court at Wilmington, Del., by United Chromium, Inc., of New York, against Chrysler Corp., alleging infringement of two patents covering chromium-plating methods. The two patents involved were issued to Colin G. Fink, one on April 20, 1926, for a process of electrodepositing chromium and preparation of baths, and the other issued on April 28, 1931, for a process of producing chromium-plated articles. Mr. Fink assigned the patents to the Chemical Treatment Co., Inc., and the latter assigned them to the Chromium Corp. of America, which later assigned them to United Chromium, Inc.

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Philadelphia Quartz Co. Completes Century

ON July 21 the Philadelphia Quartz Co. will officially mark its entry into the second century of business. On that date in 1831 a factory was founded in Philadelphia by Joseph Elkington for the manufacture of soap and candles. For 30 years these were the chief products of the plant, and in 1861 production of silicates was established and has been maintained up to the present. Since 1904 all efforts have been concentrated on the development of manufacture and uses of silicate of soda. The company now operates nine plants.

Teachers of Engineering Study Industry Needs

CHEMICAL engineering education received increased impetus as the result of the summer school for engineering teachers held at the University of Michigan, June 23 to July 9, under the auspices of the Society for the Promotion of Engineering Education. This session, the first to be devoted exclusively to chemical engineering, was followed by a two-day conference directed by the American Institute of Chemical Engineers for a discussion of the personnel requirements of industry. Director Harry P. Hammond, of the S.P.E.E., announced that 70 teachers had completed the course. They came from 47 colleges in 27 states. The instructional and lecture staff included more than thirty men from the leading chemical engineering enterprises of the United States.

The institute conference was formally opened July 10 by Prof. White, as representative of the A.I.Ch.E. committee on chemical engineering education, of which Dr. H. C. Parmelee is chairman. Norman A. Shepard told how the Firestone Tire & Rubber Co. selects and trains engineering recruits. The cadet course has succeeded better than the apprentice method in this industry, which is contrary to the situation in the food field, reported by Dr. L. V. Burton, editor, *Food Industries*. Francis M. Turner reported that students in more than one hundred schools now use the Chemical Engineering Catalog as a reference tool. Copies of older editions are distributed gratuitously.

A symposium on "How may teachers keep growing professionally?" was led by Prof. John C. Olsen, president of the institute, with Dean Sadler, of Michigan, and Prof. William Patrick Ryan, of M.I.T., outlining the policies of their institutions in respect to industrial consultation and cooperation.

A great deal of interest centered in the discussion by Prof. White of the preliminary results of a questionnaire sent to 1,000 chemical engineering graduates in order to trace their course of advancement in industry. All of the classes since 1920 from five typical schools were represented among the 771 graduates who reported. At the end of ten years 22.1 per cent were in plant operation, 19.2 per cent in research, 13.7 per cent in sales, 11.7 per cent in general engineering, 10.8 per cent in teaching, 7.5 per cent in semi plant development, 4.6 per cent in analytical laboratories, and 10.4 per cent in graduate work and miscellaneous occupations. Beginning salaries averaged $1,800, with $2,700 after five years and $4,100 after ten years.

Of the industries selected by the graduates, petroleum led with 12.3 per cent of the total; organic chemicals followed with 9.01; heavy chemicals and rubber each had 5.04; steel, gas, paint, and paper had about 4 per cent each; while food, rayon, ceramics, power, automotive, and chemical equipment each accounted for about 1 per cent of the total. The completed compilations are to be published in a later paper by Prof. White.

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International Congress for Testing Materials

A FIRST international congress has been instituted by the new International Association for the Testing of Materials, to be held Sept. 6-12 in Zürich. Domestic interest in the movement is being represented by the American Society for Testing Materials, many of whose members belong to the international body. As might be expected, the objectives are principally the attainment of international cooperation through the exchange of views and experience in all matters connected with materials testing. Standardization of materials, one of the chief functions of the A.S.T.M., is not yet an active endeavor.

The technical program has been divided into the four groups: metals, nonmetallic inorganic materials, organic materials, and questions of general importance. Americans who will have a part in the program include D. J. McAdam, Jr., U. S. Naval Engineering Experiment Station; Prevost Hubbard, the Asphalt Institute; C. S. Reeve, the Barrett Co.; Lincoln T. Work, assistant professor of chemical engineering, Columbia University; H. F. Moore, University of Illinois; and W. H. Fulweiler, United Gas Improvement Co.

Following these sessions, there will be the annual meeting of the Institute of Metals lasting from Sept. 13 to 15 at the Eidgenössische Technische Hochschule, Zürich.

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Sugar Outlet Sought In New Plastic

UNDER the name "Sakaloid," a new plastic has been announced, the principal constituent of which is polymerized sugar. This desirable combination of a new product and a pure, inexpensive raw material with hitherto restricted use, has been reported by a British engineer, Arthur F. Ford, who developed it in a search for a more satisfactory electrical insulating material, eight years ago.

The process, as explained to *Chem. & Met.*, involves the use of any commercial sugar, molasses, or glucose, which is boiled to a thick syrup, filtered, and then treated with an aldehyde or similar polymerizing agent, with or without the presence of a catalyst, depending on the properties desired.

This product varies from a water-soluble gel to a hard, brilliant, water-white solid which can be molded by casting in open forms or by reducing to shreds and then molding under pressure, either in the hot or cold. Although experimental results have not yet been released for publication, it is said to have a light-permeability ranging through the ultra-violet, and does not discolor with age, since the transmitted light tends rather to bleach any color that may have been originally present. Pigmentation gives color stability, of course, but eliminates transparency.

By virtue of its mechanical properties, it can be produced through a long range of flexibility, beginning with the softness and elasticity of crude rubber, and reaching a glassy hardness. Any product throughout this range can be permanently produced. Machining of all kinds is easily performed, but it also can be supplied in solution for coatings. Furthermore, it is extruded through spinnerets for artificial fiber.

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Petroleum Trade Accepts Market Code

THE Federal Trade Commission has been notified by the American Petroleum Institute that the institute's board of directors has approved and accepted the 21 trade practice rules for the petroleum industry as embodied in the National Code of Practices for Marketing Refined Petroleum Products revised, reapproved, and promulgated by the Commission on June 12.

In a letter to Otis B. Johnson, secretary of the Commission, W. R. Boyd, Jr., executive vice-president of the institute, presented a copy of the resolution and said he had been instructed by the board of directors to "signify to the Commission our approval, adoption, and acceptance of said rules as trade practice conference rules to be used by the petroleum industry with the Commission's approval."

The resolution was adopted by a mail vote of the board well within the 60 days from June 12 granted by the Commission for consideration and acceptance of the revised code, and represents approval by the petroleum industry of marketing rules already signed by more than 16,000 petroleum marketers.

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Commercial Solvents and DuPont Form Subsidiary

THE Commercial Solvents Corp., E. I. du Pont de Nemours & Co., and its affiliated company, the Grasselli Chemical Co., are jointly forming a new company to be known as the Krebs Pigment & Color Corp. This will consolidate the lithopone and dry color business of Krebs Pigment & Chemical Co. and the pigment and dry color division of Grasselli with the titanium of pigment business of Commercial Pigments Corp., a subsidiary of Commercial Solvents Corp.

It is likely that the organization will be completed about Aug. 1 with Carl H. Rupprecht, now manager of the pigment and color division of Grasselli, as president, with a main office at Newark, N. J. The new company will have plants at Newport, Del.; Newark, N. J.; and Baltimore, Md., the latter producing titanium oxide.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

METHANOL PRODUCERS have accepted the recommendations of the U. S. Public Health Service for denaturation of methanol intended for use as an anti-freeze. Effective from July 1 last, the agreement provides that no compound containing more than 15 per cent free methanol shall be marketed unless the following formula is complied with: (*a*) Sufficient methyl violet to give an intense and permanent color to the solution: equivalent to addition of 0.01 lb. of methyl violet 2B to 100 gal; (*b*) antimony-potassium tartrate, 0.4 lb., dissolved in each 100 gal.; chloracetophenone, 0.4 lb., dissolved in each 100 gal.; and triethanolamine, 0.1 gal., mixed with each 100 gal.; (*c*) at least 20 per cent water by volume.

The distinctive color, the bad odor, and loathsome taste that these denaturants impart to the compound are regarded as sufficient warning against its use for beverage purposes. Positive assurance that the use of methanol as an antifreeze will not result in poisoning if drunk, accidentally or otherwise, is provided by the antimony-potassium tartrate, which, in itself poisonous, is a powerful emetic. If further warning is necessary, the chloracetophenone has the same effect as tear gas.

The agreement provides that containers display the skull and crossbones and a "poison" label reading "poison: contains over 15 per cent methanol (methyl alcohol, wood alcohol); cannot be made non-poisonous; avoid spilling."

The agreement defines methanol as including the products commonly known as methanol, methyl alcohol, wood alcohol, wood naphtha, or any trade material which is essentially CH_3OH.

Manufacturers have pledged themselves to respect the terms of the agreement, but the opinion is expressed in some quarters that the quantities of denaturing substances specified are excessive for the purpose intended. This may lead eventually to some modification of the formula after the trade and public have become familiar with the present provisions.

A significant feature of the agreement is the provision that no methyl alcohol shall be used for new purposes in industry until the conditions under which it can be used with safety are scientifically established.

ELIMINATION six months ago of wood alcohol has raised a problem in complete denaturation of ethyl alcohol that is still baffling the chemists of the Bureau of Industrial Alcohol. They believed that they had found the answer in the introduction of alcotate, a very obnoxious petroleum derivative and claimed to be bootleg-proof. In practice, however, the new formula, which also included aldehol, was not an unqualified success in preventing diversion, and the odor was so bad that it brought complaints from commercial users.

Effective July 15, this formula, known as C. D. No. 5 and the only completely denatured formula authorized by the Bureau, was revised. Alcotate and aldehol remain the principal deterrents to beverage use, but the addition of turpineol, a perfume base, masks the objectionable odor and isopropanol acts as an emetic. The new formula is as follows: to every 100 parts by volume of ethyl alcohol of not less than 160 deg. proof add 5 parts by volume of denaturing grade isopropanol, 0.75 part by volume of a compound or one similar thereto known as aldehol Grade A, 0.75 part by volume of the compound or one similar thereto known as alcotate, 0.25 part by volume of commercial alphaterpineol.

Isopropanol, a petroleum alcohol, distills at about the same temperatures as ethyl alcohol and the three other constituents of the formula also distill in the same range, with the result that "cleaning" becomes an intricate and costly process. Bureau chemists are hopeful, therefore, that the bootleg trade will turn to some other source of illegal alcohol. The Bureau has no intention of reverting to the use of wood alcohol as a denaturant and if the revised formula does not prove to be effective, it will continue its efforts to develop a combination that will frustrate diverters and at the same time furnish a product that is satisfactory for commercial use.

THE chemical industry, in common with others, is disturbed by a tendency on the part of professional organizations, such as the American Medical Association, to set themselves up as judges of the purity of food, drug, and other products offered for sale to the public. From the manufacturers' standpoint such schemes have in them an element akin to racketeering, as the self-appointed organization is able by using some such device as a seal of approval to influence public good will, thus constraining the producer to accept any recommendations, arbitrary or otherwise, that the organization may have to make regarding the composition or advertisement of his products.

It is not hard to believe that such schemes, represented as protection for the consuming public, may be carried to the point where an industry is obliged to pay toll to the organization which has fastened itself to the business. This may take such an innocent form as fees charged for testing or certification, but manufacturers and distributors opposed to this interference with their business assert that the collection of any money under such circumstances is extortion pure and simple and that the system as a whole imposes duress upon them which is repugnant to ethical business principles and much more onerous than legal regulation.

Such attempts to set up outside control of manufacture and merchandising that derives its only authority from the credulity of the public also are regarded with resentment because the industries peculiarly susceptible to this form of intimidation already are subject to regulation by law that Congress considers adequate to protect the public interest.

PROHIBITION Bureau officials were cheered by the news early this month that the Corn Products Refining Co. has paid a fine of $5,000 in the federal district court at Springfield, Ill., on a plea of *nolo contendere* to charges of conspiracy to violate the prohibition law in the sale of corn sugar to bootleg distillers. Enforcement officials were frank to admit, however, that they had observed no diminution in the use of corn sugar for illicit beverage purposes since the company was indicted 18 months ago with the Fleischmann Yeast Co., J. C. Hubinger Bros. Co., and numerous individuals alleged to be supplying the bootleg trade with its raw materials. The Fleischmann Co. is contesting the charges made by the government. The Hubinger company was found guilty several months ago.

Seizures made during April by prohibition agents included 91,204 lb. of corn sugar and 291,635 gal. of corn sugar mash.

An estimate of the quantity of corn sugar consumed in production of illegal alcohol during the fiscal year ended June 30 last will be included in the next annual survey by the Bureau of Prohibition estimating "possible" production of illegal liquor from all sources. In the first report of this character, covering the fiscal year ended June 30, 1930, the Bureau estimated that of a total estimated production of 894,986,000 lb. of corn sugar in 1929, approximately 25 per cent can be accounted for in legitimate manufacture. This amounts to 223,747,000 lb., leaving a balance of 534,000,000 lb. possibly available for illegal use. Seizures of corn sugar during the fiscal year ended June 30, 1930, totaled 75,000,000 lb.

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DuPont Brings Suit on Duco Patents

Suit has been brought in the United States District Court for the Eastern District of New York by E. I. du Pont de Nemours & Co. against the Glidden Co., alleging infringement of Du Pont's Duco patents, Flaherty Reissue No. 16,803 and Hitt No. 1,710,453.

Revival of Activity in British Rayon Industry

Society of Chemical Industry Now Holding Jubilee Meeting

From Our London Correspondent

AT THE MOMENT there is an air of expectancy in the chemical industry, probably engendered by the general belief that the worst is over and that the trials and tribulations of the past twelve months have created such a friendly feeling in adversity that the outlook is one of increasing confidence and better times. Prices of chemicals as well as of raw materials are still unduly low, but owing to a definite revival in the rayon business and a certain amount of stimulation in the basic industries, the trend of business has already taken an upward direction which undoubtedly will be accentuated by a successful outcome of President Hoover's proposals.

The jubilee meeting of the Society of Chemical Industry next month probably will be unique in size and scope, and the arrangements are such as to stimulate public interest as well as provide an unusual opportunity for getting together. Substantial subscriptions to the entertainment and general purposes fund have been made by the leading firms and individuals in the industry, and the program for the convention is both attractive and interesting, supported as it is by the presence of royalty and the entertainment of the guests at the Guildhall by the Lord Mayor of London. The exhibition of chemical plants, which is a feature of the convention, opens on July 13, and apart from the social side the visits to important factories and research stations are unusually comprehensive and worth while.

Another special occasion will be the reception of original members of the society dating back to 1882, at one of the City Companies' halls, and the presentation to original members and to some ten distinguished foreign members of a plaque which has been specially struck for the occasion. The foreign recipients, who include Dr. Engi, of Switzerland; Dr. Schnicht, of Aussig, Czechoslovakia; Dr. C. L. Parsons, secretary of the American Chemical Society; Dr. Sörensen, General Patart, and H. W. Matheson, of Shawinigan; will also have honorary membership of the society conferred upon them.

A SPECIAL jubilee number of the *Journal* of the society will be published and there has already appeared from the pen of Dr. Stephen Miall a masterly volume written specially for the occasion entitled "A History of the British Chemical Industry," and numbering 273 pages. There is a foreword by Sir Harry McGowan, president of the society and chairman of Imperial Chemical Industries. Dr. Miall was probably uniquely qualified for writing this book, which does justice not only to the society but to British chemical industry as a whole, and to the British pioneers who have contributed to its world-wide distribution.

As previously mentioned, there has been a welcome revival in rayon production, and at the same time a continuance of the elimination of the weaker undertakings, among which may be numbered the British Acetate Silk Co., of Stowmarket, where both acetate and viscose rayon were to be made. Courtaulds have now entered the transparent cellulose sheeting field, and will of course be the first to benefit from a revival in the rayon trade, both as regards viscose and acetate. The recent serious illness of E. Lunge has deprived Courtaulds of the services of one of their directors with an international outlook and great driving power.

AMONG the King's birthday honors was the conferment of the Order of Merit on Sir William Bragg, F.R.S. Dr. C. H. Lander, Director of Fuel Research, has been appointed to the professorship of engineering at the City and Guilds College of London University. Dr. Lander received his degree at Manchester University, and before entering government service had ample experience as a lecturer and teacher. He will be missed at the Fuel Research Board, where under very difficult circumstances he carried out an amount of useful work which has resulted in a research and experimental station second to none in the world.

Although the low-temperature carbonization process which was evolved at the Fuel Research Station did not prove an economic success when tried out by the Gas Light & Coke Co., it probably can be truthfully said that the result might have been the same whatever process had been tried out. There is little doubt that the official tests carried out under the auspices of Dr. Lander with various low-temperature processes have materially added to our knowledge, and when the hydrogenation of low-temperature oils is successfully accomplished, the pioneer work of the Fuel Research Station will be seen in its proper perspective. Prof. C. H. Desch, F.R.S., who at present occupies the chair of metallurgy at Sheffield University, has been appointed to succeed Dr. Walter Rosenhain, in charge of the metallurgical department of the National Physical Laboratory. Prof. Desch will take up his duties early in 1932, after returning from the course of lectures which he is to give at Cornell University.

The Chemical Industry Club has decided that in future it will be simpler to change its name to the Chemical Club, in order that no one may feel debarred from joining by reason of possessing only academic or scientific, as distinct from industrial, qualifications.

THE Einstein Electro-Chemical Co., formed as the result of large public subscriptions, is breaking away from its original activities in the electroplating field and is using its resources in the development of two or three promising processes under the advice of qualified experts. Under new management and not yet having spent all its capital, this concern may survive, thanks to the exploitation of inventions which could probably have been better developed by existing firms having the facilities and means already available.

The Fuel Research Board has just published Technical Paper No. 31, relating to the removal of sulphur compounds in water gas. One object of this investigation was to consider whether sulphur compounds could be removed sufficiently to enable water gas to be more generally used in hydrogenation processes. It was found that the cost of purification, using activated carbon, would be about 0.6c. per 1,000 cu.ft., which compares favorably with the cost of purification by dry oxide, or even by the Koppers process and other wet purification plants. Such a process may therefore be applicable to ordinary gas-works practice, and apparently licenses may be obtained from the Department of Scientific and Industrial Research in regard to a charcoal reactivation process covered by British Patent No. 337,348. In the course of these investigations, some interesting comparisons were made between Silica Gel and activated charcoal in regard to their capacity for the removal of organic and other sulphur compounds.

ANOTHER report of the Fuel Research Board which has just been published deals with experiments on the Berginization of coal and oil. As regards coal, this report deals mainly with the preliminary stages during hydrogenation. It is doubtful whether this work will be continued on any comprehensive scale, seeing that the economic conditions are unfavorable and that there are many other workers in the field.

Considerable interest is being shown in the new process of Prof. Teatini, of Belgium, who is using small quantities of liquid sulphur dioxide to reduce the quantity of lime required in the defecation and clarification of sugar juice. Apart from the saving in lime, greatly improved results as regards increase in production, reduced sugar losses, and a saving in evaporation and filtration are claimed. The process is being tried out in several factories on the Continent and in England, and it would seem probable that the claims of the inventor will be substantiated as the result of operations during the forthcoming campaign. Prof. Teatini is not only the general manager of a large sugar factory but from his writings it is clear that he is a scientist and theoretical investigator of ability.

Zinc and Titanium Pigments Make Progress in France

Restrictive Measures Cut Down Use Of White Lead

From Our Paris Correspondent

WE MENTIONED in a previous letter that the main French producer of aluminum was the Alais Froges Camargue Co., whose yearly output reached 22,000 tons, 40 per cent of which up to 1930 was sold on a foreign market. The latter has reduced its purchases from 40 per cent to 30 per cent and probably will buy even less in 1931.

The aluminum trade is still prosperous, however, as its sales prices are amply remunerative, considering the low cost price; and the use of aluminum also are increasing. The last reduction in sales prices was made in October. At the International Colonial Exhibition now being held in Paris one of the exhibits is specially equipped to show all the uses of aluminum and its alloys in the chemical trade and similar industries.

The zinc industry, on the contrary, is severely handicapped by the world crisis. The following figure will show to what extent: in June, 1931, zinc was exactly eleven times cheaper than when it reached its highest price. This clearly explains why the important zinc companies of La Vieille Montagne and L'Asturienne Des Mines have not paid dividends to their shareholders this year. According to the trade authorities, prospects in the zinc industry are gloomy, present sales prices being not sufficiently remunerative to pay shareholders. It should be added, however, that the French zinc output is only a small fraction of the world production, reaching about 6.2 per cent in 1929 and 6.4 per cent in 1930. But the above mentioned companies control works in foreign countries, zinc foundries, and electrolytic zinc factories. As a matter of fact the present excessive zinc output is mainly due to the development of electrolytic zinc, which is an almost 100 per cent pure metal.

UP TO 1929, a trust regulated the home output of zinc and a new agreement probably will shortly reunite the partners of the aforesaid trust if, as it is hoped, the new agreement is strictly observed by all.

Zinc works also produce zinc oxide or zinc white, either by the direct combustion of the metal or by the reduction of zinc ore immediately followed by oxidation of the vapors produced—i. e., by the direct process or indirect process, which enables the output of zinc white at different grades of thinness and whiteness, according to needs.

The total output of the five French zinc works was only about 8,300 tons in 1913 and, as the home needs reached 10,000 tons, imports were necessary. Now exports exceed imports; 2,500 tons of the former against 2,100 tons of the latter in 1929.

Another mineral color containing zinc is lithopone, which is manufactured on a far larger scale in France since the bill prohibiting the use of white lead in paints. This law was voted a few months before the beginning of the World War, and because of this, the use of white lead was tolerated and even now it is not entirely prohibited. However, the use of white lead is gradually disappearing, as lithopone is now manufactured in sufficient quantities to supply all the home needs and even export 1,400 tons yearly, in spite of keen competition from titanium white.

THE Thann works, of Alsace, produce yearly about 600 tons of pure titanium white by the Blumenfeldt process. Ilmenite is attacked by sulphuric acid, iron sulphate is separated, and the subsequent titanium sulphate is hydrolized.

The Société Française du Titane uses the Carteret-Devaux process, which is based on the preparation of titanium tetrachloride (by the action of chlorine on coal and titanium ore) and hydrolization of the titanium tetrachloride yielded after separation from ferric chloride. The Société Française du Titane sells composite titanium white—i.e., a mixture of titanium oxide and sulphate of barium. Imports of this mineral color increased from 300 tons in 1928 to 750 tons in 1929. These figures include both the concentrated product and products mixed with sulphate of barium or other mixtures.

Up to now production of mercury was insignificant in France. New mercury bearings lying near Constantine (Algeria) will shortly be worked by the Société des Mines de Ras-el-Mla, a firm with a working capital of 3,500,000 francs.

The Ras-el-Mla works have just been built and will treat a daily output of 120 tons, yielding a yearly output of about 200 tons of mercury. As the home needs are about 200 tons, this output should be easily absorbed by the domestic market.

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Ursolic Acid Extracted By Government Chemist

REPORTS from Washington state that Dr. Charles E. Sando, of the Bureau of Chemistry and Soils, has perfected a method for extracting ursolic acid, a new chemical, from the waxlike coating of apple peels. By this method the compound is extracted from apple pomace. Recently Dr. Sando sent samples to several commercial concerns for study by their research departments.

Ursolic acid appears to have promising possibilities for commercial use. Perhaps the most promising one is in the paint and varnish industry. The fact that the powder is resinous to the touch and is water-repellent suggested its use in varnishes. Preliminary tests made by the American Paint and Varnish Manufacturers' Association show that ursolic acid increases the gloss and water-resistance of cellulose lacquers.

Another effect of adding small quantities of ursolic acid to lacquers is to extend the time required for drying. This seemed to improve the brushing qualities of the lacquers so treated, especially for the first coat.

If there is sufficient demand it would be possible to produce 500,000 lb. of ursolic acid in this country annually, it is estimated.

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Birmingham to Have Chemical Survey

THE Birmingham Industrial Board, a branch of the Chamber of Commerce, is formulating plans for a complete survey of the Birmingham district to determine fully its chemical potentialities. Only the most competent chemists will be employed in this work, and will, in the end, cover every natural resource that might possibly enter into chemical production.

H. C. Ryding, president of the Tennessee Coal, Iron, & Railroad Co., is chairman of the Industrial Board, and is very optimistic regarding the outcome.

According to W. B. Perry, secretary of the board, the intention is to assemble data showing location and availability of all materials from which chemical products have been made or can be made.

The officers of the Industrial Board are fully confident that a large development in the field of chemistry will follow when the data are placed before the various organizations interested in the industry.

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Petroleum Research Work Will Continue

PLANS for the continuation for two years, but on a smaller scale, of the five-year program in fundamental research in petroleum, which ended on July 1, have been announced by the American Petroleum Institute.

The sum of $75,000, already largely subscribed by several oil companies, will make possible further studies of petroleum occurrence, recovery, and composition. About $115,000 already has been invested in these projects out of the $100,000 contributed annually during the last five years by John D. Rockefeller and the Universal Oil Products Co. At the end of the two years it is hoped to raise funds to finance a resumption of the complete program.

Vienna Chemical Meetings Cover Wide Range of Technology

German Chemical Industry Moves in Sympathy With National Trade

From Our Berlin Correspondent

THE RECENT action of President Hoover affects the German chemical industry as it does the economic situation here as a whole. Even though the period of moratorium is only a year, a new economic epoch is foreseen. Meanwhile, the I. G. Farbenindustrie has joined other large industries in guaranteeing the government financially.

Realignment of fuel supply is taking effect as a result of long-distance supply of gas and of the growing prominence of lignite. The 1,237 million cu.m. of gas supplied by the Ruhrgas A.G. from 1928 to 1930 over long distance represents a decline of about 3.5 million tons in the coal consumption of those using the new fuel source. Meanwhile, lignite has been very successful in power generation, having already passed coal in total power generation. And in larger plants during 1929, already 80 per cent of the current was being generated by lignite.

At the meeting of the Verein Deutscher Chemiker in Vienna, about 120 papers were read, of which only a few can be reported here. Prof. S. Ehrlich, Breslau, who received the Emil Fischer Medal, spoke especially of the pectins, the constitution of which he has helped to clarify. He found that the methyl ester of a cyclic higher acid was especially effective in forming fruit jellies, while the humus acids of the soil originate principally from the pectin fraction of decaying plants. Probably coal originates from the same substance. Prof. von Braun, reporting on the constitution of petroleum, has made discoveries on the naphthenes and hopes to arrive at the constitution of the higher petroleum hydrocarbons.

MECHANISM of gaseous fuel combustion was a special topic at the oil and fuel division. Dr. Schuftan described a process of benzene production by deep cooling as developed recently by the Linde company. Benzene and naphthalene are obtained in concentrated form, and as the process operates now, it costs about the same to run as the scrubbing process. However, it is applicable in many cases where recovery was not hitherto feasible.

The production of knockproof gasoline by the Edeleanu process, according to Dr. Grote, Berlin, consists of freeing the fraction from 160 to 230 deg. C. of its saturated hydrocarbons by some suitable method. These are particularly prone to knock, whereas the rest of the fraction is knockproof. Dr. Schmidt, Breslau, also discussed the connection between chemical composition and knock qualities of fuel. Chemically pure compounds, such as naphthene, paraffin, and unsaturated hydrocarbons were added in definite proportions to motor fuels and tested. The effect of certain chain groups was studied and determined in this way.

In the division for oil and fat chemistry, Dr. Eisenstein, Vienna, demonstrated a new process for acid removal from oils and fats. A disadvantage of former processes was the introduction of neutral oil into the soap stock. If only a part of the free fatty acid of the oil is neutralized, the soap particles are not surrounded by neutral oil, as formerly, but by fatty acid. The economy of being able to neutralize without loss of neutral oil is enhanced by the savings in neutralizing agents. A further step is achieved in refineries run in connection with soap factories. The soap waste, which is otherwise returned to the kettles, can be used in the refinery for neutralizing oil, and thus convey fatty acids to the soap factory. In this process, up to 50 per cent free acid can be present in the oil. Dr. Normann Chemnitz succeeded in the catalytic reduction of carboxyl groups in higher fatty acids with copper catalysts at 300 deg. C. and over 100 atm. pressure. In this way a number of natural fats as well as fatty acids can be reduced to the corresponding alcohols, which, in turn, can be used for the synthesis of waxes and similar materials. Prof. Schrauth, Berlin, also spoke about the synthesis of waxes from high molecular fatty acids.

IN THE textile division, Prof. Heffenlund and Dr. Fromm described their process for making hollow synthetic fibers, which reverses the injection of the cellulose solution into a precipitating bath by spraying the precipitating liquid into the cellulose solution. In the division for water chemistry, Dr. Splittgerber related his practical experiences in phosphate treatment of feed waters. To prevent foaming, the hardness of the water must be reduced as far as possible before addition of phosphate. As the operating pressure increases, an excess of phosphate also is necessary. Wherever sufficient phosphates have been added, the result was always a scale-free boiler.

Dr. Stolzenberg, Hamburg, reported on colored fogs which are generated by heat-fast dyes according to a development originally begun in 1918 by Dr. Schumann. This development, for which a few spectacular uses are projected, has been made possible by the development of heat-fast dyes, as well as the reduction of the combustion temperature in the generator to about 300 deg. C.

At the meeting of the Deutsche Gesellschaft für Chemisches Apparatewesen (German Society for Chemical Equipment), filtration was treated from various aspects. P. H. Prausnitz, Jena, spoke on glass filters as an alternative for porcelain and ceramics, while Dr. Kratz, Göttingen, spoke of the advances in filtration of colloidally fine particles in membrane and porous filters. According to E. Vossen, Köln, hard rubber is now being used as a filter medium, especially against acid corrosion between temperatures of —10 and 110 deg. C. It is made by being ground after partial vulcanization and subsequent complete vulcanization in the desired forms. Various porosities are achieved and it is expected to replace filter cloth in such forms as plates, rings, and tubes. In addition, there were several talks on such special equipment as the Wolf rotary filter, the Dorr-Oliver types, and the Seitz filter.

At the Deutsche Bunsen-Gesellschaft, which also met at Vienna, A. Koenig, Karlsruhe, spoke of the electrolytic chromium plating of light metals. In this operation it is necessary to remain above certain critical current strengths and it is found best to apply the chromium directly without nickel coating. In his experiments on pure aluminum, M. Centnerzwer found that the loss in 1-2 N. nitric acid is so slight that it is noticeable only after several days, while in sulphuric acid it is still less. But in hydrochloric acid the rate of corrosion becomes constant and is directly measurable by the hydrogen generated. Contrasting this behavior with thallium, he further found that the latter behaves reversely. But other factors influence the effect, such as the formation of an insoluble chloride.

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Memorial Dedicated To P. D. Schenck

A MEMORIAL flagpole to Peirce Davies Schenck, founder of The Duriron Co., Inc., Dayton, Ohio, was dedicated recently by the employees of the company. The concrete base was designed by Dale Augsburger, member of the Dayton office, and carries a tablet cast in "Durimet," a chrome-nickel-silicon alloy steel developed by Mr. Schenck. The tablet bears the inscription: "Erected to the Memory of Peirce Davies Schenck, Founder of The Duriron Company."

The dedication address was given by Wm. E. Hall, New York City, who succeeded Mr. Schenck as president. The acceptance speech was made by Robert C. Schenck, son of the founder, and secretary.

Charles Sheeley, machine shop foreman, gave a brief history of the company and his recollections of Mr. Schenck after fifteen years of being associated with him. The flag was raised by employees who have been with the company since its inception in 1915.

MEN
IN CHEMICAL ENGINEERING

EDWIN FITCH NORTHRUP, who received the Edward Goodrich Acheson Medal for 1931, at the spring meeting of the Electrochemical Society, will receive the formal presentation at the society's meeting in Salt Lake City on Sept. 3. The medal will be bestowed in recognition of Dr. Northrup's industrial electrical inventions, especially high-frequency induction heating. Born in 1866, in Syracuse, N. Y., Dr. Northrup has spent much of his career teaching, but also has devoted much of his energy to study and invention.

H. M. VAN HORN has resigned from the Certain-Teed Products Corp., where he was chief chemist, to become chemical engineer in charge of plant control and research for the Imperial Paper & Color Corp., at Glens Falls, N. Y.

FRANK O. CLEMENTS, technical director of the research laboratories of General Motors Corp., Detroit, has been elected president of the American Society for Testing Materials for the coming year. Dr. Clements, who was

FRANK O. CLEMENTS

graduated from Otterbein College, Ohio, in 1896, was chemist with the Pennsylvania Railroad and Union Pacific Railroad before becoming chief chemist of the National Cash Register Co., in 1905. There he was active until 1917, when he went with the Dayton Metal Products Co. for three years before joining the General Motors Corp.

R. D. BEAN has been promoted from manager of the engineering developments of the Brown Instrument Co., Philadelphia, to chief engineer of the company.

ALEXANDER L. FEILD, formerly research engineer with Simonds Saw & Steel Co., has been appointed director of development and research with the Rustless Iron Corp. of America. After finishing his schooling, he joined the U. S. Bureau of Mines at Pittsburgh in 1914, and in 1917 transferred to the Union Carbide & Carbon Corp., where he stayed for eight years.

G. C. GRUBB, who was manager of the Triangle Chemical Co., New Westminster, B. C., has become head of manufacturing and sales in the explosives division of Canadian Industries, Ltd., Montreal.

HENRY L. COLES, chemical and metallurgical engineer, and vice-president of the Guardian Metals Co., Hamilton, Ohio, has received a Ph.D. degree at Ohio State University.

C. S. DIETZ, for the past four years deputy state geologist for Wyoming, has opened an office as a consultant at Cheyenne. Prior to his appointment in 1927, Mr. Dietz was federal mineral examiner. His studies, published two years ago, of the industrial possibilities of Wyoming, resulted in federal appropriations which are being applied to the development of Wyoming resources.

MAX G. PAULUS, manager of the Rocky Mountain division refineries of the Standard Oil Co. of Indiana, has been appointed assistant general manager of all manufacturing of the company and has now taken up his headquarters in Chicago. Dr. Paulus has been with the company since 1915, when he joined the Whiting refinery after graduation from Johns Hopkins University.

J. E. ROUSE has been promoted to manager of the Rocky Mountain division of the Standard Oil Co. of Indiana, to succeed Max G. Paulus.

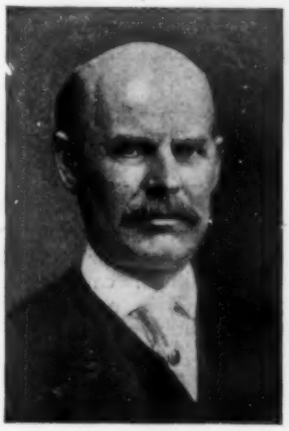
JAMES W. MCLAUGHLIN was elected vice-president of the Carbide & Carbon Chemicals Corp. at a recent meeting.

RICHARD L. BINDER, president of the Metals Coating Co. of America, Philadelphia, has sailed to Europe together with Leopold Pessel, technical head of the company.

ARTHUR W. CARPENTER, since 1928 manager of the testing laboratories of the B. F. Goodrich Co., Akron, Ohio, was elected a member of the executive committee of the American Society for Testing Materials at the meeting last month in Chicago.

S. D. KIRKPATRICK, editor, and PAUL D. V. MANNING, Pacific Coast editor of *Chem. & Met.*, have arrived at Los Angeles, from where they will undertake a tour to visit important industries along the Pacific Coast from San Diego, Calif., to Trail, B. C. Friends who wish to communicate with them can reach them at the McGraw-Hill Publishing Co.'s offices in Los Angeles and San Francisco.

CHESTER F. SMITH, who was manager of the Bayonne Refinery of the Standard Oil Co. of New Jersey, has been appointed assistant general manager of the company's three New Jersey plants. He has been with the company ever since his graduation from the University of Pennsylvania in 1913.



E. G. ACHESON

R. E. J. SUMMERS, until recently vice-president and contract manager of the H. K. Ferguson Co., has resigned to become president of Summers Engineers & Constructors, Inc., Cleveland and New York City. Mr. Summers in the past five years has been responsible for the engineering and construction of several of the larger chemical plants.

CLIFFORD C. FURNAS will leave the research staff of the U. S. Bureau of Mines at Minneapolis this summer to accept the post of associate professor of chemical engineering at Yale University, to which he has been appointed.

G. M. OEHM has joined the American Cyanamid Co. in the capacity of agricultural editor. A graduate from the University of Missouri in 1917, Mr. Oehm soon gathered a wide editorial experience here and abroad, and in 1924 joined the University of Arkansas as agricultural editor.

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OBITUARY

EDWARD GOODRICH ACHESON, one of the outstanding figures in America's independent chemical growth, died of pneumonia on July 6, at the age of 75, while in New York. He was customarily resident in St. Petersburg, Fla., and had been ill only a week. Dr. Acheson, who was born at Washington, Pa., in 1856, soon put his inventiveness to use to overcome the handicap of early

poverty. His first work was at a blast furnace at the age of 17, and for a time afterward, the depression caused him to change employment frequently. But in 1881, he received work with Thomas A. Edison and spent several years abroad working for his interests there. Even

FRANK HEMINGWAY

up to 1891, his occupations were mainly electrical, but in that year he succeeded in producing silicon carbide and in forming the Carborundum Co. at Monongahela, later at Niagara Falls. From this work he proceeded with the manufacture of artificial graphite, and in 1899 formed the Acheson Graphite Co. Another compound, Si_2C_2O, Siloxicon, followed in 1902 and, though unique, was never widely applied. A more important industrial product was a series of colloidal graphite suspensions produced by the Acheson Oildag Co., established in 1908. His resourcefulness continued unabated throughout his life, and he later coordinated his activities in the Acheson Corp. and the Goodrich Corp. In 1928, he provided the Electrochemical Society with the Edward Goodrich Acheson Medal, and last year was unanimously voted the first recipient, for his contributions to electrochemistry.

FRANK HEMINGWAY, president of Robinson, Butler, Hemingway & Co., Bound Brook, N. J., and the R-B-H Lacquer Base Co., died in New York on June 28, at the age of 55, after a long illness. Mr. Hemingway, a native of London, came to this country in 1896. The first industrial venture with which he was associated was the Nucoa Butter Co., which he organized in 1903. In 1913, he established at Bound Brook a plant to manufacture coal-tar products, similar to his father's firm in England. The company of which he was president at the time of his death was organized by him in 1925, after several years' service with the Sherwin Williams Co., of Cleveland, as manager of the development department. In addition, Mr. Hemingway was president of the Tar Distilling Corp. and vice-president of the Inland Tar Co. The controlling interest in his life was chemical manufacture, but his organizing ability was so great that he was associated in executive capacities with most of the leading societies. He was one of the organizers of the American Dye Institute and since 1908 had been treasurer of the American section of the Society of Chemical Industry.

EDWARD HART, professor emeritus of chemistry at Lafayette College and active in several industrial enterprises, died on June 6, at his home in Easton, Pa., where he had been confined at his home for a month by illness. Born in 1854 at Doylestown, Pa., Dr. Hart went permanently to Lafayette in 1878 as adjunct professor, after completing his education. He remained there until 1916, after being head of the department. Meanwhile he was founder and

EDWARD HART

president of the Baker & Adamson Chemical Co. from 1881 to 1913, and of the Chemical Publishing Co., which he owned, until his death. Dr. Hart also was active in editorial work, having had charge of several precursors of the *Journal of the American Chemical Society*.

JOHN LYONS AGNEW, vice-president of the International Nickel Co. of Canada, died at his home in Copper

JOHN LYONS AGNEW

Cliff, Ont., on the night of July 8, during his sleep. He had been ill for several days, but his condition had not been regarded as serious. Mr. Agnew was in only his 47th year, having been born in Pittsburgh in 1884. He received his education there, but went to Canada at the age of 19 and joined the Canadian Copper Co. From then on, he worked in practically every department of copper and metals refining, until the consolidation in 1929 of various companies into the International Nickel Co. of Canada, Ltd. At that time he became vice-president of the new company and an executive in the company's branch in the United States. His most recent achievement was the development and opening of the Frood Mine, the largest nickel producer in the world. He also was in charge of the construction of the new smelter at Copper Cliff, and new operations at Port Colborne, Ont. Only two weeks ago he had returned from an inspection trip of the company's subsidiary, the Mond Nickel Co., Ltd., in England.

GENTRY CASH, a director and general manager of manufacturing of the Standard Oil Co. of Indiana, died suddenly at his home in Floorsmoor, near Chicago, on July 5, of heart attack. He had been in unsatisfactory health for several months previously. Dr. Cash had only recently become manager of manufacture in Whiting, after 21 years of service with the company. His original position was chemist, and from it he rose by gradual, steady steps.

HENRY V. WALKER, president of the lacquer manufacturing company in Elizabeth, N. J., bearing his own name, died on July 4 in New York, following an operation a few days before. Dr. Walker, who was born in Brooklyn 59 years ago, studied chemistry in New York schools and was first employed in municipal work. Later he began to specialize in lacquer manufacturing, taking a prominent part in the realignment of those industries after the War. From 1925 to 1926 he was also president and general manager of the Miner Edgar Co., New York City.

CALENDAR OF FORTHCOMING EVENTS

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, fall meeting, Atlantic City, N. J., Dec. 9-11.

AMERICAN CHEMICAL SOCIETY, 82d meeting, Buffalo, N. Y., Aug. 31-Sept. 4.

ELECTROCHEMICAL SOCIETY, fall meeting, Salt Lake City, Utah, Sept. 2-5.

MATERIALS HANDLING EXPOSITION, first meeting, New York City, Nov. 30-Dec. 5.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Kalamazoo, Mich., late September.

THIRD INTERNATIONAL CONFERENCE ON BITUMINOUS COAL, Pittsburgh, Nov. 16-21.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

REPORT of Wesson Oil & Snowdrift Co., Inc., and subsidiaries for nine months ended May 31, 1931, shows net profit of $1,984,042 after depreciation, federal taxes, etc., equivalent after dividend requirements on $4 convertible preferred stock, to $1.50 a share on 600,000 no-par shares of common stock. This compares with $2,237,531, or $1.73 a share, in first nine months of previous fiscal year.

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Archer-Daniels-Midland Co. reports for nine months ended May 31, 1931, net profit of $560,458 after depreciation, federal taxes, etc., equivalent after dividend requirements on 7 per cent preferred stock, to 65c. a share on 549,546 no-par shares of common stock. This compares with $1,159,752, or $1.74 a share, in the corresponding nine months of previous fiscal year.

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Heyden Chemical Co. has declared a dividend of 50c. on the common stock, payable Aug. 1 to stock of record July 15. This dividend is the first that has been declared since December, 1930.

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The Swann Corp., with main offices at Birmingham, Ala., has declared its regular quarterly dividend of 15c. a share on Class A and B stocks.

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Notices have been sent to stockholders of the Standard Oil Co. of New York and the Vacuum Oil Co., calling special meetings for July 30 to vote on the proposed merger of the companies. A vote will also be taken on the change of name of the new holding company from the General Petroleum Corp. to the Socony-Vacuum Corp.

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The Kali-Chemie A. G. of Berlin has declared a dividend of 7 per cent for 1930, which compares with 9 per cent paid in the preceding year. Changes in balance sheet items during the year were quite numerous. For example, the plant investment, in spite of the allowances for depreciation, has been raised to the extent of 6,390,000 reichsmarks. More than half of this total represents the value of the Heyl-Beringer properties, which have been taken over by the Kali-Chemie A. G., while the remainder is accounted for by expansion in other plants. Inventories also rose about 1,900,000 reichsmarks.

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Dow Chemical Co. reports for year ended May 31, 1931, net profit of $2,377,200 after charges and taxes, equivalent after 7 per cent preferred dividend requirements, to $3.44 a share on 630,000 no-par shares of common stock. This compares with $2,782,017, or $4.08 a common share, in preceding fiscal year.

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Libbey-Owens-Ford Glass Co. will issue $9,000,000 of 5 per cent serial notes to finance the purchase of the National Plate Glass Co., at Ottawa, Ill., a subsidiary of General Motors Corp. The General Motors Corp. has subscribed for $3,500,000 of the notes at par, plus accrued interest, in part payment for the two factories it is selling Libbey-Owens-Ford.

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Clinton S. Lutkins, vice-president, director, and member of the executive committee of the Allied Chemical & Dye Corp., and George M. Wells, vice-president of the corporation in charge of sales, have resigned, effective June 30. Both men were elected vice-presidents of the corporation at the recent annual meeting.

Price Range Jan.-June, 1931			Price Range in June			
High	Low	Stock	June 1	High	Low	June 30
19¼	5	Agfa Ansco Corp	8¼	10	7	....
109¾	70¼	Air Reduction	71¼	90	70¼	84¾
182¾	102¾	Allied Chemical	104	133¼	102¾	128¾
224	90	Aluminum Co. of America	92	146	90	133¼
29¾	11¼	Am. Ag. Chemical, Del	12¾	19	11¼	18
14¾	5¼	Am. Commercial Alcohol	7¼	9¾	6¼	9
12¼	6¼	American Cyanamid, B	6¼	9¼	6¼	8¼
8	1¼	American Hide & Leather	4	6¼	2¼	6¼
23¾	8¼	American Metals	8¾	16¼	8¼	13¾
4¼	1¼	American Solvents & Chemical	2	2	1¼	2
18	8	Archer-Daniels-Midland	8¼	11¼	8¼	10¼
4¼	1¼	Armour, Ill., A	1¼	2¼	1¼	2
23¼	11¼	Atlantic Refining	11¼	17¼	11¼	15¼
54	30	Atlas Powder	32¼	38	30	....
62	44¼	Beechnut Packing	45	53	44¼	....
1¼	¼	British Celanese	....	1¼	1¼	....
25	25	California Petroleum	....	....	....	....
10	5	Celluloid Corp	....	....	....	....
7¼	2¼	Certain-teed	3¼	6	3¼	6
12¾	10	Chickasha Cotton Oil	....	10¼	10	....
50¼	40	Colgate-Palmolive-Peet	43¼	47	40	45¼
111¼	55	Columbian Carbon	56¼	83¼	55	79¼
21¼	10¼	Commercial Solvents	11¼	16¼	10¼	14¾
86¼	55¼	Corn Products	56¼	76	55¼	74
23	9¼	Davison Chemical	10	14¼	9¼	13
19¼	11	Devoe & Raynolds, A	....	14¼	11	....
51	34	Dow Chemical	34¼	45	34	....
107	71	Du Pont	72	92¼	71	89¼
124	118¼	Du Pont, 6 pc. deb	122¼	122¼	120	....
3¼	1¼	Duval Texas Sulphur	....	2	1¼	....
185¼	118	Eastman Kodak	125¼	156¼	118	148
21¼	13	Firestone Tire	16¼	20	16	19
¼	¼	Fisk Rubber	¼	¼	¼	¼
43¼	22	Freeport Texas Sulphur	24¼	30	22	28
47	15¼	General Asphalt	16	26¼	15¼	23¼
16¼	7¼	Glidden	8¼	11	7¼	10¼
42¼	21	Gold Dust	22	32¼	21	30
20¼	8¼	Goodrich Co	8¼	15¼	8¼	13¼
58	40	Hercules Powder	....	46	43	....
13	9	Heyden Chemical	....	9¼	9	....
4¼	2¼	Imperial Chemical, Ltd	....	3¼	3¼	....
86	21¼	Industrial Rayon	28	36¼	21¼	32¼
5¼	1¼	Int. Ag. Chemical	1¼	2¼	1¼	....
20¼	9¼	International Nickel	10	16¼	9¼	15¼
10¼	4	International Paper, A	....	6	4	5
42	29¼	International Salt	30¼	37	29¼	34¼
16¼	10	Kellogg, Spencer & Sons	....	15	11¼	15
3¼	1¼	Kelly-Springfield	1¼	2¼	1¼	2¼
4¼	2¼	Lee Rubber & Tire	3	3¼	2¼	....
34¼	22¼	Lehn & Fink	25	27¼	22¼	27
20¾	11¼	Libbey-Owens	13¾	20	12¼	18¼
55¼	20¼	Liquid Carbonic	24¼	35¼	20¼	31¼
17	7¼	McKesson & Robbins	10	11¼	7¼	10¼
31¼	17¼	Mathieson Alkali	18¼	25¾	17¼	22
26¼	18¼	Monsanto Chemical	19	24¼	18¼	23
36¼	19¼	National Distillers Products	23¼	29¼	22	27¼
132	85	National Lead	88¼	126¼	85	122
51	35	New Jersey Zinc	....	40¼	35	....
53	41	Newport Corp., A	43¼	43¼	41	....
19¼	7	Ohio Oil	7¼	11¼	7	10¼
39¼	25¼	Owens-Ill., Glass	28¼	32¼	25¼	32
16¼	4¼	Phillips Petroleum	5¼	9¼	4¼	8¼
42¼	29¼	Pittsburgh Plate Glass	....	33	29¼	....
40¼	33	Pratt & Lambert	35	36	33	....
71¼	56	Procter & Gamble	57	65¼	56	64¼
11¼	5¼	Pure Oil	5¼	8¼	5¼	8¼
66¼	52	Sherwin-Williams	52¼	60	52¼	....
12	3¼	Silica-Gel	4	6	4	....
15¼	6¼	Sinclair Oil	6¼	11	6¼	10¼
12¾	3¼	Skelly Oil	3¼	6	3¼	5¼
51¼	31¼	Standard Oil, Cal	33¼	39¼	31¼	37¼
52¼	30¼	Standard Oil, N. J	32	41¼	30¼	38¼
26	14¼	Standard Oil, N. Y	15	18¼	14¼	17¼
45¼	31	Sun Oil	31¼	36¼	31	....
3¼	2¼	Swan & Finch	....	....	....	....
30¼	24¼	Swift & Co	25¼	26¼	24¼	26¼
9¼	5¼	Tennessee Corp	5¼	7¼	5¼	7
36¼	18	Texas Corporation	19	24¼	18	23
55¼	29¼	Texas Gulf Sulphur	34¼	39¼	29¼	37¼
9	4	Tidewater Assoc. Oil	4¼	6¼	4	5¼
16	3¼	Tubize-Chatillon, B	4¼	7	4	....
72	43¼	Union Carbide	44¼	55¼	43¼	52¼
26¼	14	Union Oil, Cal	16¼	19¼	16	18¼
28¼	13	United Carbon	13¾	19¼	13	16¼
77¼	24¼	U. S. Industrial Alcohol	27¼	33¼	24¼	30
10¼	3¼	U. S. Leather	5¼	8	4¼	7¼
20¼	10¼	U. S. Rubber	10¼	17¼	10¼	15¼
69¼	22¼	Vacuum Oil	26¼	44¼	22¼	42¼
76¼	23¼	Vanadium Corp	24	38¼	23¼	35
3¼	1	Va-Car. Chemical	....	1¼	1	....
26¼	17¼	Wesson Oil	19	23¼	18¼	22
40	18	Westvaco Chlorine	....	27	18	26¼
3¼	1¼	Wilson & Co	1¼	2¼	1¼	....

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Slower Rate of Operations Rules in Chemical Industry

Seasonal Declines Reported in Withdrawals Against Existing Contracts

THE summer season usually brings a slowing up in production and distribution of chemicals, and the present year offers no exception to this rule. Since the first of the month many large consumers are reported to have lessened their activities and both contract movement and spot trading are described as quiet. The fertilizer industry continues to lag and tag sales in 16 states for June were approximately 93 per cent of those for June, 1930. The backwardness of the fertilizer trade for the year to date has had considerable effect on the sulphuric-acid trade and has weakened values for the acid in Southern sections.

Fertilizer plants reporting to the Department of Commerce produced a total of 671,710 short tons of sulphuric acid during the first five months of the current year, compared with 949,562 tons in the corresponding period of 1930, and 914,097 tons in the first five months of 1929.

Total of sulphuric acid consumed in fertilizer establishments and shipped to other than fertilizer manufacturers amounted during the first five months of 1931 to 683,345 short tons, against 1,080,480 tons in the corresponding period of 1930, and 1,006,209 in the first five months of 1929.

Statistics covering production and consumption of some branches of the chemical and related industries follow:

	May, 1931	May, 1930
Production		
Acetate of lime, 1,000 lb.	2,953	6,819
Methanol, crude, gal.	247,808	426,395
Methanol, refined, gal.	118,052	405,780
Methanol, synthetic, gal.	784,108	583,486
Arsenic, crude, ton	1,491	1,652
Arsenic, refined, ton	1,044	963
Automobiles, cars, no.	269,080	364,512
Trucks, no.	45,695	55,075
Taxicabs, no.	340	440
Byproduct coke, 1,000 ton	3,126	4,266
Plate glass, 1,000 sq.ft.	9,466	12,571
Rosin, wood, bbl.	33,593	40,933
Turpentine, wood, bbl.	5,996	7,454
Pine oil, gal.	210,012	234,281
Petroleum, refined, 1,000 bbl.	78,521	83,647
Cottonseed oil, crude, 1,000 lb.	28,019	46,539
Cottonseed oil, refined, 1,000 lb.	36,470	55,976
Sulphuric acid, by fertilizer manufacturers, ton	97,729	188,887
Consumption		
Cotton, bales	465,770	473,284
Silk, bales	45,073	40,823
Rubber, ton	37,817	39,902
Sulphuric acid, in fertilizer trade, ton	101,602	210,779

Sales of plastic paints in May were larger than in any of the preceding months of this year, reaching a total of 966,745 lb. Sales for the first five months of the year were 4,332,086 lb., which compares with sales of 5,374,997 lb. for the corresponding period of 1930. Sales of calcimines for the first five months of the year amounted to 16,275,049 lb., against 21,341,478 lb. for the like period of 1930.

WHILE general industrial conditions this year have cut down the volume of business in certain lines of chemicals and price cutting has affected products, the industry as a whole has been in a sound condition. An exception is found in the case of naval stores, where overproduction, reduced buying interest, and loss of export trade have brought about an unsettlement which reveals the industry as being in a chaotic state. Last week application was made before the Farm Board for financial assistance, so that a degree of stability might be effected. At the last session of Congress naval stores were included among agricultural products as defined by the Agricultural Market Act and hence they are eligible for Farm Board loans.

The outlook for the movement of chemicals in the third quarter of this year does not compare favorably with that for the corresponding period of last year, according to reports of the Shippers' Regional Advisory Boards, but the international situation has improved since the issuance of those reports and trade opinions are more optimistic.

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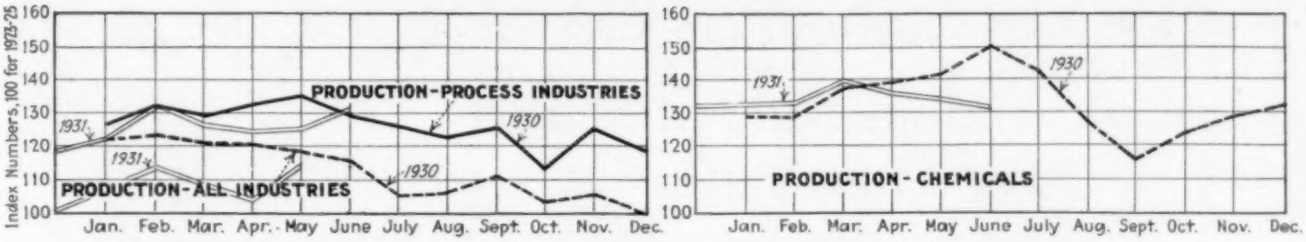
Byproducts Obtained From Coke-Oven Operations in 1930[a]

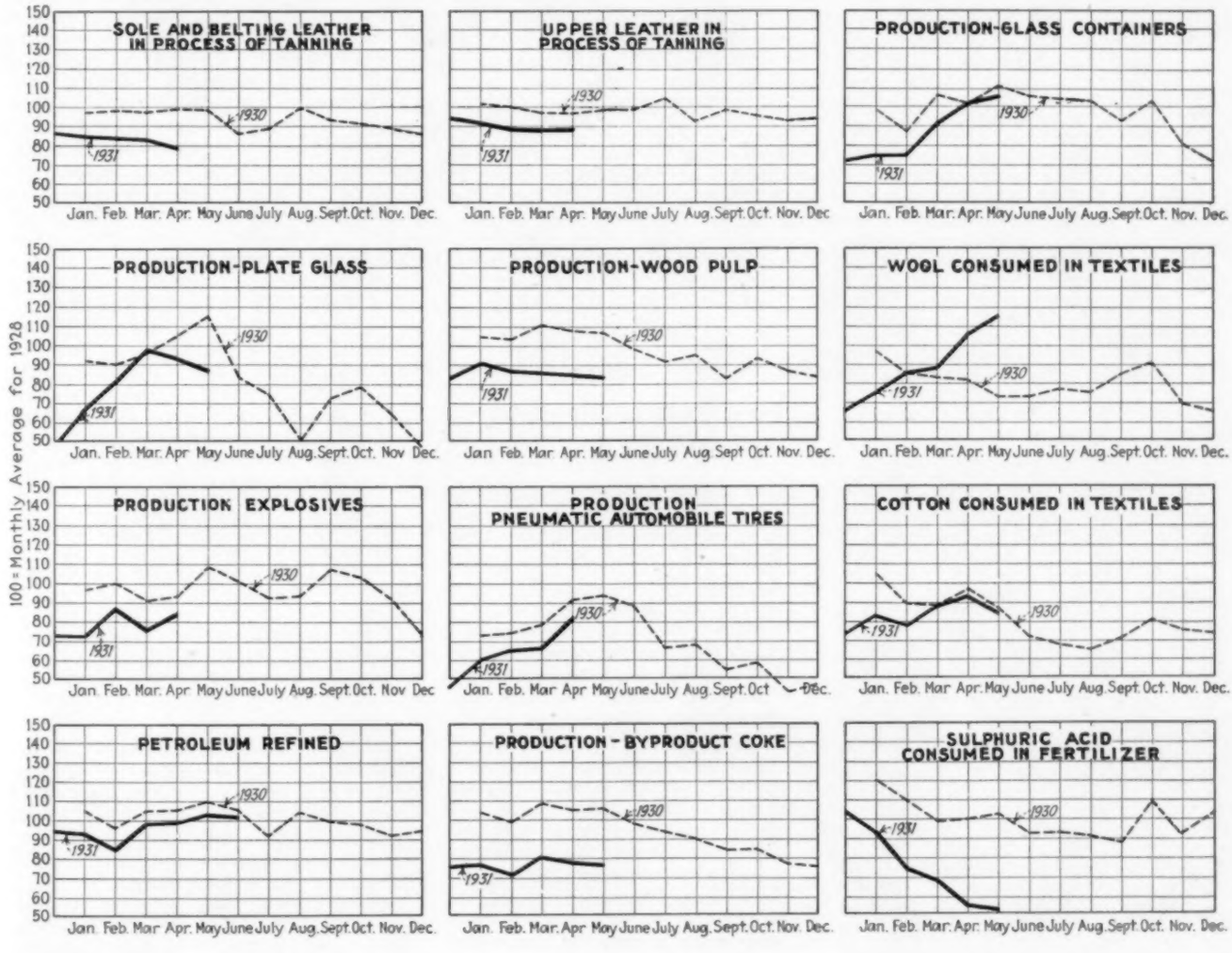
Product	Unit	Production	Sales — Quantity	Sales — Value — Total	Sales — Value — Average
Tar	gal.	602,485,929	314,865,294	$15,562,963	$0.054
Ammonia:					
Sulphate	lb.	1,341,919,960	1,310,588,322	20,448,633	.016
Ammonia liquor (NH_3 content)	lb.	49,031,133	45,368,290	2,236,063	.049
	.....	.....	.....	22,684,696	.....
Sulphate equivalent of all forms	lb.	1,538,044,492	1,492,061,482	.....	.....
Gas:					
Used under boilers, etc.	M. cu.ft.	[b]724,103,004	20,408,659	1,185,415	.058
Used in steel or affiliated plants			231,232,552	24,903,906	.108
Distributed through city mains			164,689,727	48,938,752	.297
Sold for industrial use			25,787,390	4,266,064	.165
			$442,118,328	79,294,137	$0.179
Light oil and derivatives:					
Crude light oil	gal.	[c]178,325,952	9,941,904	983,540	.099
Benzol, crude and refined	gal.	19,142,910	19,187,627	3,377,026	.176
Motor benzol	gal.	101,862,692	102,572,989	14,427,422	.141
Toluol, crude and refined	gal.	11,833,202	12,083,423	3,613,778	.299
Solvent naphtha	gal.	4,078,274	3,647,773	651,146	.179
Xylol	gal.	2,040,024	1,891,764	481,863	.255
Other light oil products	gal.	6,475,725	1,983,034	120,115	.061
		[d]145,432,827	151,308,514	$23,654,890	$0.156
Naphthalene, crude and refined	lb.	12,640,102	13,028,904	$161,264	$0.012
Tar derivatives:					
Creosote oils	gal.	29,236,681	28,570,764	$2,500,076	.088
Phenol (crude)	gal.	136,971	104,546	38,241	.366
Pitch of tar	tons	106,334	7,465	46,914	6.284
Other tar derivatives	.....	.....	.....	55,376	.....
Other products[f]	.....	.....	.....	95,164	.....
Value of all byproducts sold	.....	.....	.....	[g]144,093,721	.....

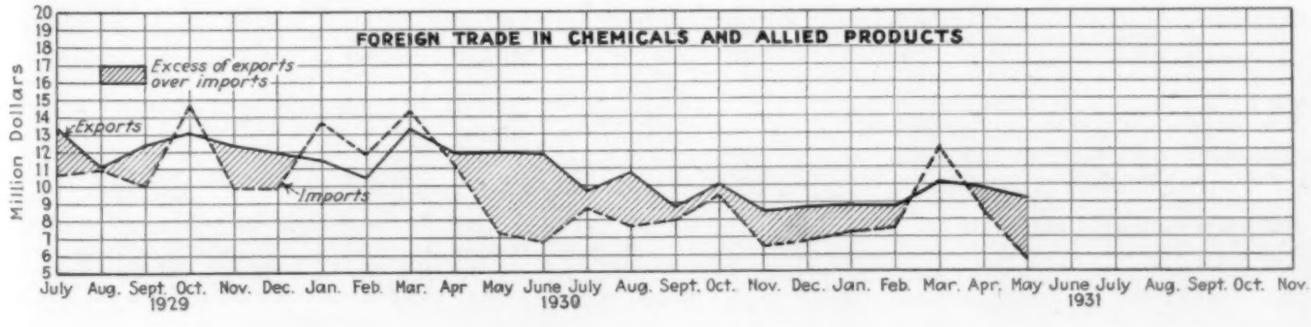
(a) Includes products of tar distillation conducted by coke-oven operators under same corporate name, excepting however, phenol, and other tar acids produced at Clairton, Pa., which are covered by report of the U. S. Tariff Commission. (b) Includes gas wasted and gas used for heating retorts. (c) Refined on the premises to make the derived products shown, 173,328,254 gal. (d) Total gallons of derived products. (e) Includes creosote oil distilled as such, and distillate in coal-tar solution. (f) Crude products, tar paint, carbolate, sodium prussiate, sulphur, smoke compound, extil covering, and cyanogen. (g) Exclusive of the value of breeze production, which in 1930 amounted to $9,408,549.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



Based on electrical power consumption, data supplied by Electrical World




FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Million Dollars
Excess of exports over imports
Exports
Imports
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1929
1930
1931

MARKET CONDITIONS —AND PRICE TRENDS

Quiet Conditions Rule in Market For Chemicals

Seasonal Slowness Affects Many Large Consuming Industries

GOOD call has been reported for chemicals which enter into refrigeration, road building, and insecticides. Producers of copper sulphate have found late-season demand larger than had been anticipated, and total movement during June and July to date has been considerably above normal. In general, however, the movement of chemicals has been slowed up by seasonal conditions. Declines are reported in deliveries to the glass, fertilizer, and pulp industries. Large outputs of finished leather goods have been announced and demand for hides has been greatly stimulated, but the tanning branch of the industry has not yet reflected this condition.

The U. S. Tariff Commission announced on June 24, that import duties on seven items or groups of items have been changed under the flexible provision of the Tariff Act of 1930 and that the changes have been approved by the President, thus making the new rates immediately effective. This included a reduction from 9½c. per lb. to 8c. per lb. on olive oil weighing, with the immediate container, less than 40 lb. The lower duty carries no significance from a manufacturing standpoint but it places packaged olive oil in a better position to compete with other edible oils. Dried egg yolk and dried egg albumen were made subject to an import duty of 27c. per lb., which is an increase of 9c. per lb. over the previous rate.

It also is announced that tariff investigations of flaxseed, linseed oil, and feldspar have been ordered. The investigation of flaxseed resulted from an application for a lower duty made by the Association Nacional de Agricultura, Buenos Aires. The request for an investigation into feldspar came from the Consolidated Feldspar Corp. of Ohio and also asks for a decrease in duty.

WHILE demand for industrial alcohol has been of moderate proportions, the price has been well maintained. On June 25 the Treasury Department announced a new formula for completely denatured alcohol effective July 15. For each 100 parts of ethyl alcohol of not less than 160 proof there shall be added for denaturing purposes 0.5 part of denaturing grade isopropanol, 0.75 part of a compound or one similar thereto known as aldehol grade A, 0.75 part of alcotate and 0.25 part of commercial alpha terpineol.

In the formula now in use there is one part aldehol, 1.25 parts alcotate, but no isopropanol or terpineol. Government chemists expressed the belief that the new denaturants would prove just as effective as either of the two preceding formulas and the new alcohol would be more satisfactory to the consumers.

As a result of an agreement between the U. S. Public Health Service and manufacturers of methanol, effective July 1, anti-freeze mixtures of more than 15 per cent methanol henceforth are to be identified by added quantities of purple coloring matter, tartar emetic, and chloracetophenone or tear gas.

By the agreement, moreover, all solutions of over 15 per cent free methanol, whether used in industry or in anti-freeze mixtures, are to be labeled plainly: "poison"; and, as when used in anti-freeze products, are to contain the prescribed additional amounts of identifying coloring matter and chemicals.

New Potash Discovery In Russia

A report to the Department of Commerce states that new important potash deposits have been discovered in Usbekistan, in the Karaliuk district. Usbekistan is one of the federated Soviet republics situated in the cotton belt of Asiatic Russia and the importance of the new deposits is chiefly in connection with the Soviet plans for expansion in cotton planting. The deposits are stated to be unusually large and not deep under ground, so that mining operations can be carried on by most primitive methods. The government of the Usbekistan republic has requested the Soviets in Moscow to send a geological commission to survey the potash fields with a view to early exploitation.

AMONG the developments of the month of market significance was the announcement that the Victor Chemical Works had acquired extensive phosphate deposits of the Globe Phosphate Co. in Tennessee. It also was reported that a plant would be erected near Portland, Ore., for the manufacture of tannic acid. Waste materials of paper mills, especially hemlock bark, will furnish the raw-material supply.

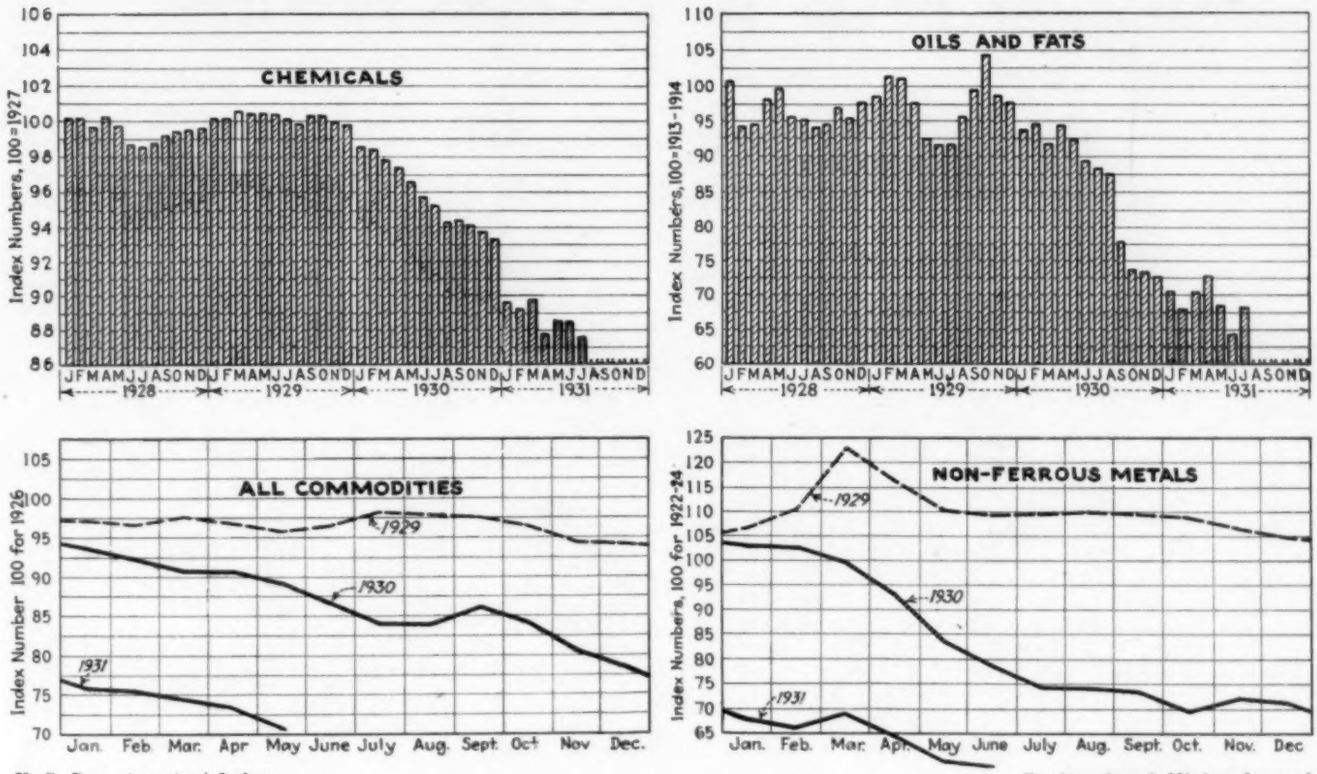
In England it was reported that a new and improved process for the manufacture of copper sulphate has been perfected by the Mond Nickel Co., and installed at its Clydach works, which will now be able to produce 50,000 tons of this commodity a year.

From Mexico comes a report that a surface deposit of sulphur has been discovered about 50 miles from Marfa. The deposit is described as covering several square miles, rising above the surface to a height of 10 ft. to 25 ft. It is described as 100 per cent sulphur.

In Canada the new oleum plant of the Canadian Industries, Ltd., in Sudbury, Ont., is nearly complete and will soon be in operation. Part of the equipment for the new mill was transferred from Coniston, Ont., where in 1925, two 30-ton units were erected for the production of sulphuric acid by the contact method.

The Department of Commerce reports that the new Chinese export tariff on tung oil, which increased the duty more than three times the old rate, was placed in effect June 1. According to the regular monthly tung oil cable dispatched by the consulate at Hankow under date of July 6, the exports of oil from Hankow during June were considerably below the May figures, indicating that the new duty has had an effect on the export trade. The total June exports of tung oil from Hankow were 964,000 lb., of which 930,000 lb. went to the United States and 34,000 lb. to Europe. Domestic consumption of tung oil was estimated at 2,000,000 lb. while stocks of oil on hand at Hankow the end of June were reported to be 800 short tons. Exports of wood oil from Hankow for the first half of this year were 52,514,000 lb., compared with 87,374,000 lb. for the corresponding period of 1930. Of the above totals, 43,922,000 lb. was consigned to the United States this year and 74,456,000 lb. in 1930. The higher export tax and the rise in exchange had the effect of increasing sales prices for wood oil in domestic markets.

CHEM. & MET. *Weighted Indexes of* PRICES



U. S. Department of Labor — *Engineering & Mining Journal*

Large Stocks Depress Values of Naval Stores

CONSUMING demand for spirits of turpentine has proved disappointing and foreign trade likewise has dropped below the levels reached a year ago. As a result there has been a sharp downward movement in market prices during the last month. Reports from Southern centers state that stocks of turpentine at ports on July 1 amounted to 104,048 bbl., compared with 45,697 bbl. on July 1, 1930, or a gain of more than 127 per cent. Exports of turpentine for the first five months of this year were reported at 3,175,517 gal., compared with 3,949,564 gal. for the corresponding period of last year. This represents a decline of more than 19 per cent.

Receipts of turpentine at Southern shipping points for April-June, the first three months of the present naval stores year, were less than 120,000 bbl., compared with 127,386 bbl. for the comparable period of 1930. These comparisons clearly indicate that reduced values are the result of a falling off in demand rather than increased offerings at primary points. Reports from European markets indicate that stocks are not unusually large, in view of predicted smaller outputs, but consumers are not interested in American offers, because the price differential is in favor of European producers. This would indicate that our export outlook is not favorable unless a readjustment of values places the American product in a competitive position.

The importance of Russia in European naval stores trade is indicated by a report from our trade commissioner in Rome, who states that import statistics show that during the first quarter of 1931 Italy received from Soviet Russia 1,866 metric quintals of turpentine and 1,277 quintals of rosin. These figures are of particular interest and consideration is given to the fact that during the first quarter of 1930 only 271 quintals of turpentine and no rosin were imported from the same country.

The position of rosin is about the same as that reported for turpentine, with foreign and domestic trade quiet, stocks large, and prices declining.

While price concessions continue to be given in sales of certain chemicals, no special weakness developed during the month and quoted prices for the most part were unchanged. In some cases open quotations are firmly maintained in transactions, with every indication that the bottom has been reached.

Vegetable oils, on the other hand, showed a tendency to appreciate in value and higher prices ruled for most selections.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**87.51**
Last month	88.49
July, 1930	95.15
July, 1929	100.03

Sharp declines in prices for turpentine were largely instrumental in reducing the weighted index number during the month. Ethyl acetate, sodium phosphate, and some of the acid selections also showed price weakness.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**68.05**
Last month	64.39
July, 1930	88.28
July, 1929	91.84

Higher prices became effective for the majority of vegetable oils, although crude cottonseed oil was largely nominal. Crude menhaden oil sold at lower levels and present values may have the effect of cutting down fishing activities.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 11.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.10 -$0.11	$0.10 -$0.11	$0.11 -$0.12
Acid, acetic, 28%, bbl., cwt.	2.60 - 2.85	2.60 - 2.85	3.11 - 3.26
Glacial 99%, tanks	8.98 -	8.98 -	-
drs.	9.23 - 9.48	9.23 - 9.48	-
U. S. P. reagent, c'bys.	9.73 - 9.98	9.73 - 9.98	-
Boric, bbl, lb.	.06½- .07	.06½ - .07	.06½- .07
Citric, kegs, lb.	.36 - .37	.36 - .37	.46 - .47
Formic, bbl, lb.	.10 - .11	.10 - .11	.10½- .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl, lb.	.11½- .12	.11½ - .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.35 - .40
Tartaric, powd., bbl., lb.	.30½- .33	.30½- .33	.34½- .36
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.33 -	2.33 -	2.63 - 2.71
Alcohol, Butyl, tanks, lb.	15½-	15½-	.16½- .17
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.206-	.236-	- .236
Denatured, 188 proof			
No. 1 special dr., gal.	.27 -	.27 -	.42 -
No. 5, 188 proof, dr., gal.	.27 -	.27 -	.42 -
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.05½- .06
Potash, lump, bbl., lb.	.03½- .04	.03½- .04	.03 - .03½
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.25 - 1.40	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb	.02½- .03	.02½ - .03	.03 - .04
tanks, lb.	.02½- .02½	.02½- .02½	-
Ammonia, anhydrous, cyl., lb	.15½- .15½	.15½- .15½	.15½ -
tanks, lb.	.05½-	.05½-	-
Ammonium carbonate, powd. tech., casks, lb.	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt.	1.75 -	1.75 -	2.00 -
Amylacetate tech., tanks, lb., gal	.172-	.172-	.222-
Antimony Oxide, bbl., lb.	.08 - .09	.08½- .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	58.00 -60.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64.00 -70.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033-	.033-	.033-
Bromine, cs., lb.	.36 - .38	.36 - .38	.45 - .47
Calcium acetate, bags	2.00 -	2.00 -	3.00 -
Arsenate, dr., lb.	.06 - .07	.06 - .07	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20.00 -	20.00 -	20.00 -
flake, dr., wks., ton.	22.75 -	22.75 -	22.75 -
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06 - .07
Chlorine, liquid, tanks, wks., lb.	.01½-	.01½ -	.024 -
Cylinders	.04 - .06	.04 - .06	.04½- .06
Cobalt oxide, cans, lb.	1.35 - 1.45	1.75 - 1.85	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 - 14.00	13.00 -14.00
Copper carbonate, bbl., lb.	.08½- .18	.08½ .17	.10 - .18
Cyanide, tech., bbl., lb.	.41 - .46	.41 - .46	.45 - .46
Sulphate, bbl., cwt.	3.70 - 4.00	4.25 - 4.50	4.75 - 5.00
Cream of tartar, bbl., lb.	.23½- .24	.23½ - .24	.26½- .27
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.11 - .13
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.06 -	.07 -	.106-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.07½- .08
Furfural, dr., contract, lb.	.10 - .12	.10 - .12	.10 - .12
Fusel oil, crude, drums, gal.	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal.	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.11½- .12	.12½ - .13	.13 - .14
Lead:			
White, basic carbonate, dry casks, lb.	.07½-	.07½-	.07½-
White, basic sulphate, sck., lb	.07 -	.07 -	.07½-
Red, dry, sck., lb.	.07½-	.07½-	.08½-
Lead acetate, white crys., bbl., lb	.11 - .12	.11 - .12	.13 - .13½
Lead arsenate, powd., bbl., lb.	.10 - .14	.11 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., sck, lb.	.06½-	.06½-	.07½-
Lithopone, bags, lb.	.04½- .05	.04½- .05	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.38 -
97%, tanks, gal.	.34 -	.34 -	.39 -
Synthetic, tanks, gal.	.37½-	.37½-	.40½- .45
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.13 - .13½
Single, bbl., lb.	.10½- .11	.10½- .11	.13 - .13½
Orange mineral, csk., lb	.09½-	.09½-	.11 -
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08½- .09
Cyanide, cs., lb.	.55 - .57	.55 - .57	.52 - .55
First sorts, csk., lb.	.08½- .09	.08½- .09	.08½- .09
Hydroxide (c'stic potash) dr., lb	.06½- .06½	.06½- .06½	.06½- .06½
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.04?- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	15.00 -18.00	20.00 -22.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.32 -
Dense, bags, cwt.	1.17½-	1.17½-	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.90 - 3.00
Acetate, works, bbl., lb.	.05 - .05½	.04½- .05	.04 - .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton.	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03 - .04
Chlorate, kegs, lb.	.05½- .07½	.05½- .07½	.07½- .08
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00- 14.00
Cyanide, cases, dom., lb.	.16½- .17	.16½- .17	.18 - .20
Fluoride, bbl., lb.	.07½- .08	.08 - .08½	.08 - .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt.	2.05 -	2.05 -	2.07 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.0265 - .03	.0265- .03	.03½- .03½
Prussiate, yel. drums, lb.	.11½- .12½	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.03½- .04
Sulphite, cyrs., bbl., lb.	.03 - .03½	.03 - .03½	.02 - .03
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.07 - .08
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. -	nom. -	nom. -
Oxide, bbl., lb.	.29 -	.25 -	.36 -
Crystals, bbl., lb.	.25½-	.24 -	.27½-
Zinc chloride, gran., bbl., lb.	.06½- .06½	.06½- .06½	.06½- .06½
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.41 - .42	.40 - .41
Dust, bbl., lb.	.05½- .06	.05½- .06	.07½- .08
Zinc oxide, lead free, bag, lb.	.06½-	.06½-	.06½-
5% lead sulphate, bags, lb.	.06½-	.06½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½-$0.11	$0.10½-$0.11	$0.11½-$0.12½
Chinawood oil, bbl., lb.	.07½-	.06½-	.09 -
Coconut oil, Ceylon, tanks, N.Y., lb.	.04½-	.04½-	.06½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.06½-	.07½-	.06½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.06½-	.06 -	.07½-
Linseed oil, raw, car lots, bbl., lb.	.092-	.087-	.138-
Palm, Lagos, casks, lb.	nom.-	.05 -	.06 -
Niger, casks, lb.	nom.-	.04½-	.05½-
Palm Kernel, bbl., lb.	.05 -	.05½-	.07½-
Peanut oil, crude, tanks (mill), lb	.07 -	.07 -	.07½-
Rapeseed oil, refined, bbl., gal.	.45 - .47	.46 - .48	.70 - .72
Soya bean, tank (f.o.b. Coast), lb.	nom.-	nom.-	.08½-
Sulphur (olive foots), bbl., lb.	.05½-	.05½-	.07½-
Cod, Newfoundland, bbl., gal.	.40 - .44	.40 - .44	.55 - .57
Menhaden, light pressed, bbl., gal	.34 - .36	.34 - .36	.54 - .55
Crude, tanks (f.o.b. factory), gal.	.20 -	nom.-	nom.-
Whale, crude, tanks, gal.	nom.-	nom.-	- .80
Grease, yellow, loose, lb.	.02½-	.02½-	.04½-
Oleo stearine, lb.	.07½-	.06½-	.08½-
Red oil, distilled, d.p. bbl., lb	.08½-	.08½-	.10½-
Tallow, extra, loose, lb.	.03½-	.03 -	.05½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.57 - .60
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal.	.19 - .20	.19 - .20	.21 - .22
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.12½ - .14	.13 - .14	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.54 - .58	.54 - .58	.60 - .70
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.30 - .31
Dinitrotoleun, bbl., lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.26 - .28
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.39 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.68 - .70
Naphthalene, flake, bbl., lb.	.03½ - .04½	.03½ - .04½	.04½ - .05
Nitrobenzene, dr., lb.	.08½ - .09	.08½ - .09	.08½ - .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.29 - .31
Phenol, U.S.P., drums, lb.	.14½ - .15	.14½ - .15	.14½ - .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.75	1.50 - 1.80	1.50 - 1.80
R-salt, bbl., lb.	.40 - .44	.40 - .44	.44 - .45
Resorcinal, tech., kegs, lb.	1.00 - 1.15	1.15 - 1.25	1.15 - 1.25
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.25 - .30	.25 -	.28 - .30
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.91 - .93
Toluene, tanks, works, gal.	.29 -	.30 -	.35 - .....
Xylene, com., tanks, gal.	.25 - .28	.25 - .28	.25 - .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	06 - .11	.07 - .11	.13½ - .16
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.03 - .20	.03 - .20	.05 - .22
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	5.00 - 5.40	5.00 - 5.40	6.00 - 6.50
Para toner, lb	.75 - .80	.75 - .80	.77 - .80
Vermilion, English, bbl., lb.	1.65 - 1.70	1.65 - 1.70	1.90 - 2.00
Chrome yellow, C. P., bbl., lb.	16½ - .17	16½ - .17	.17 - .17½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - 08½	.04 - .05
Cum copal Congo, bags, lb.	.06 - .08	.06 - 08	.07½ - .08
Manila, bags, lb.	.16 - .17	.16 - .17	.16 - .17
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.18 - .19
Kauri No. 1 cases, lb.	.45 - .48	.45 - 48	.48 - .53
Kieselguhr (f.o.b. N. Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -.....	40.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	4.95 -.....	6.50 -.....	5.85 -.....
Turpentine, gal.	.43 -	.56 -.....	.43 -.....
Shellac, orange, fine, bags, lb.	.38 - .40	.38 - .40	.50 - .52
Bleached, bonedry, bags, lb.	.28 - .30	.30 - .31	.36 - .37
T. N. bags, lb.	.16 - .17	.16 - .17	.27 - .28
Soapstone (f.o.b. Vt.), bags, ton	10 00 -12.00	10 00 -12.00	10 00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	9.50 -.....
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -.....	13.75 -.....	13 75 -.....

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0 19½ $0 22	$0.19½ $0.22	$0.22 -$0.24
Beeswax, ref., light, lb.	.27 - .28	27 - .28	.35 - .36
Candelilla, bags, lb.	.14 - .15	14½ - .15	.18 - .19
Carnauba, No. 1, bags, lb.	.28 - .29	.37 - .40	30 - .32
Paraffine, crude			
105-110 m.p., lb.	03¼ 03¾	03½ - 03¾	.04¼ - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.	$200.00-	$200.00-	$200.00-
Ferromanganese, 78-82%, ton.	80.00 85 00	80.00-85.00	94.00-99.00
Ferrochrome, 65-70%	.11-	.11-	
Spiegeleisen, 19-21%, ton.	30 00-	30 00	34.00
Ferrosilicon, 14-17%, ton	39 00	39 00	39.00-
Ferrotungsten, 70-80%, lb.	1.00- 1.10	1 10	1.20
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.50	3.15-3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0 08 -	$0 08 -	$0.11½-
Aluminum, 96-99%, lb.	.233	233-	.233 -
Antimony, Chin. and Jap., lb.	.07	063-	.06½ -
Nickel, 99%, lb.	35 -	35 -	35 -
Monel metal, blocks, lb.	28 -	28 -	28 -
Tin, 5-ton lots, Straits, lb.	.22½ -	.22½	29½ -
Lead, New York, spot, lb.	.044-	03½-	.052 -
Zinc, New York, spot, lb.	.04½ -	.036 -	.0447 -
Silver, commercial, oz.	.29½ -	.26½ -	.34½ -
Cadmium, lb.	.55 -	.55 -	70 -
Bismuth, ton lots, lb.	1.50 -	1.50 -	1.00 -
Cobalt, lb.	2.50 -	2.50 -	2.50 -
Magnesium, ingots, 99%, lb.	48 -	.48 -	.85 - 1.10
Platinum, ref., oz.	40.00	27.50 -	43.00
Palladium ref., oz.	19.00- 21.00	19 00- 21.00	26 00-28.00
Mercury, flask, 75 lb.	85.00 - 90.00	100.00	117.00-
Tungsten powder, lb.	1 65-	1 65-	1.70- 1.75

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.	$6 50- $8 25	$6 50- $8.25	$7.50- $8.00
Chrome ore, c.f. post, ton.	19.00- 24 00	19.00- 24 00	21.50- 25.00
Coke, fdry., f.o.b. ovens, ton.	2.75- 2 85	2 75- 3.85	2.75- 2.85
Fluorspar, gravel, f.o.b. Ill., ton.	17.25- 20.00	17.25- 20.00	18 00- 20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.24 - .25	.24 - .25	.31 - .36
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.35 - .40	35 - .40	.48- .50
Monazite, 6% of ThO_2, ton.	60.00 -	60 00 -	60.00-
Pyrites, Span. fines, c.i.f., unit.	13 -	13 -	13 -
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit	11.50 - 12.00	11.50 -12.00	15.25 -16.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

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Alum Process Building — Merrimac Chemical Co., Chemical Lane, Everett, Mass., awarded contract for a 1 story alum process building to J. F. Griffin Co., 250 Stuart St., Boston. Estimated cost $40,000.

Ammunition Plant Development—Bureau of Yards & Docks, Navy Dept., Washington, D. C., awarded contract for development of Naval Ammunition plant including 131 buildings, 11½ mi. railroads, and 14¼ mi. paved roads, at Oahu, Hawaii to Thomas Haverty, 316 East 8th St., Los Angeles, Calif. $2,000,000.

Brass and Copper Products Plant—H. M. Hillman, 188 Flatbush Ave. Ext., Brooklyn, N. Y. (manufacturers of brass and copper products), will award contract about July 15 for alterations to storage building at Flatbush and Myrtle Aves. E. Owre, 53 Fort Hill Circle, St. George, S. I., is architect.

Brick, Tile and Clay Plant—Parker Brick Co., recently incorporated, E. E. Roberts, vice pres., Reno, plans construction of a plant for manufacture of brick, tile and clay at Reno, Nev. Estimated cost exceeds $40,000.

Kiln Shed, Etc.—Empire State Pipe Corp., 158-28 33rd Ave., Flushing, N. Y., plans the construction of a 1 story, 82 x 100 ft. kiln shed and 1 story, 20 x 177 ft. work shed.

Ceramics Building — State Dept. of Education, Albany, N. Y., awarded contract for the construction of a ceramics building, also service connections (tunnels) at Alfred University, Alfred, to Havens Construction Co., Olean. $109,000.

Pottery Plant—Weller Pottery Co., Zanesville, O., awarded contract for addition to factory No. 3, doubling present capacity on Ceramic Ave., to Austin Co., Union Trust Bldg., Pittsburgh, Pa. Estimated cost 100,000.

Glass Factory—Owens-Illinois Glass Co., 133 Kearny St., San Francisco, Calif., is having plans prepared for the construction of a glass factory at Fernside Tract. Estimated cost $1,500,000. Private plans.

Cellophane Plant — Canadian Industries Limited, Hamilton, Ont., plans the construction of a plant for manufacture of cellophane. Estimated cost $1,500,000.

Cement Plant — San Jose Cement Co., E. H. Dettner, Pres., 835 Howard St., San Francisco, Calif., awarded contract for the construction of a cement plant, initial capacity, 3,500 bbl., at San Jose, to Hunt-Mirk & Co., 141 Second St., San Francisco. Estimated cost $2,250,000. Kilns and mills will be furnished by Polysius Corp., Bethlehem, Pa.

Chemistry Building—Bd. of Regents, A. & M. College, College Station, Tex., plans the construction of a 2 and 3 story chemistry building, also 2 or 3 story agricultural engineering building. Estimated cost $350,000 and $200,000 respectively. F. E. Giesecke is college architect.

Chemical Building—Dept. of Education, Education Bldg., Albany, N. Y., will receive bids

until July 14 for the construction of chemical building at New York State Agricultural Experiment station at Geneva.

Chemistry Building—Stone & Webster, 49 Federal St., Boston, Mass., Const. Mgrs., awarded contract for superstructure of 5 story, 50 x 300 ft. chemistry building at Cambridge for Massachusetts Institute of Technology, Charles River Rd. to Scully Co., 258 Main St., Cambridge. Estimated cost $800,000.

Chemical Plant—Ethyl Gasoline Corp., 135 East 42nd St. and Dow Chemical Co., 60 East 42nd St., New York, N. Y., plans the construction of a plant for extraction of bromides from sea water at Wilmington, Del. Estimated cost to exceed $5,000,000.

Chemical Plant—"Z" Canyon Project c/o H. L. Cooper, 101 Park Ave., New York, N. Y., is having preliminary plans prepared for the construction of a large chemical plant in connection with hydro-electric plant, 650,000 hp. total capacity on the Columbia River at Newport, Wash., 20 miles from Canadian line. Estimated total cost approximately $17,600,000. Maturity indefinite.

Sulphuric Acid, Calcium Carbide, Calcium Chloride, etc.—A. L. Flint, Gen. Purch. Officer, Panama Canal, Washington, D. C., opens bids July 23 for sulphuric acid, dye, varnishes, linseed oil, quicklime, calcium carbide, calcium chloride, etc.

Cotton Bleaching Plant — Commander Mills Inc., c/o H. B. Howell, Supt. Sand Springs, Okla., awarded contract for construction of 2 story, 57 x 107 ft., cotton bleaching plant to W. R. Grimshaw, Philcade Bldg., Tulsa, Okla. filtration equipment to Roberts Filter Co., Darby, Pa.; water softener to Permutit Co., 440 Fourth Ave., New York; pumps and motors to Allis-Chalmers Co., West Allis, Milwaukee, Wis., and chemical feeders and chlorinization equipment to Wallace & Tiernan Co., Belleville, N. J. Estimated cost approximately $100,000.

Candy Factory—Dilling Candy Co., Morris and Chocolate Sts., Indianapolis, Ind., will build factory addition. Estimated cost $40,000. Owner builds.

Salt Plant—Texas Salt Products Co., R. L. Drake, vice pres. and gen. mgr., Room 1643, 135 East 42nd St., New York, will build addition to plant at West Tulsa, Okla. Estimated cost approximately $800,000. Owner builds with local labor.

Gas Plant—Arizona Edison Co., W. C. Hornberger, V. Pres. and Gen. Mgr., Phoenix, Ariz., plans converting artificial gas plant and system to use natural gas. Estimated cost $75,000.

Laboratory—Connecticut Agricultural Experimental Station, Huntington Rd., New Haven, Conn., is having preliminary plans prepared for the construction of an agricultural and experimental laboratory. Estimated cost $50,000. D. Orr, 956 Chapel St., New Haven, is architect.

Laboratory—Dept. of Health, 505 Pearl St., New York, N. Y., plans the construction of a baby health center and laboratory at Brooklyn. Maturity November or later.

Laboratory—Dept. of Health, 505 Pearl St., New York, N. Y., plans a baby health center and laboratory at Jamaica. $150,000. Maturity late winter.

Laboratories—Dept. of Health, 505 Pearl St., New York, N. Y., will receive bids about Nov. 1 or later for the construction of baby health centers and laboratories at Astoria and St. George. Estimated cost $150,000 each.

Laboratories, Etc.—Dept. of Hospitals, Municipal Bldg., New York, N. Y., will receive bids about Aug. 1 for the construction of a 2 story, 33 x 100 ft. laboratory and morgue at Randalls Island, $100,000; also plans laboratory and morgue at Wards Island, $100,000. Maturity later. Van Wart & Wein, 347 Madison Ave., New York, are architects.

Laboratories—School District No. 1, Arkadelphia, Ark., will receive bids until July 21 (extended date), for the construction of a 3 story, 135 x 206 ft. high school, incl. science laboratories, etc. Estimated cost $140,000. Petter & McAninch, Pyramid Life Bldg., Little Rock, are architects.

Laboratories—Wellesley College, E. F. Pendleton, Pres., Wellesley, Mass., plans the construction of a building to house physics, chemistry and geology departments on college grounds. Estimated cost to exceed $40,000. Architect not selected.

Laboratory (Chemical)—Merrimac Chemical Co., Chemical Lane, Everett, Mass., awarded contract for 2 story, basement, irregular sized laboratory building, Chemical Lane, to John Griffin & Co., Inc., 250 Stuart St., Boston. Estimated cost $50,000.

Laboratory (Chemical)—Maas Chemical Co., 308 East 8th St., Los Angeles, Calif., is receiving bids for a 1 and 2 story, 55 x 140 ft. chemical laboratory at Alvarado and Valley Sts. H. R. Kelley, Architects Bldg., Los Angeles, is architect.

Laboratories (Engineering & Gas Testing)—Ethyl Gasoline Corp., 135 East 42nd St., New York, N. Y., will soon award contract for addition to engineering and gas testing laboratory at Detroit, Mich., also at Baton Rouge, La. Estimated cost $40,000 and $35,000 respectively.

Laboratories (Geology)—California Institute of Technology, Pasadena, Calif., awarded contract for two 3 story, 60 x 134 and 100 x 125 ft. geology laboratories to Wurster Construction Co., 307 Architects Bldg., Los Angeles. Estimated cost $500,000.

Laboratory (Oceanographic)—Bd. of Regents, University of Washington, Seattle, Wash., will open bids July 28 for construction of 3 story, 60 x 135 ft., laboratory on campus. Estimated cost $225,000. J. Graham, Dexter Horton Bldg., Seattle, is architect.

Laboratory (Photographic) — Constructing Quartermaster, Fort Monroe, Va., will receive bids until July 16 for the construction of a photographic laboratory at Langley Field. Estimated cost $41,000. Private plans.

Laboratory Equipment—Bd. of Regents, University of Texas, Austin, Tex., appropriated $45,000 for new equipment for laboratory at Galveston.

Lamp Factory—Guide Lamp Co., Anderson, Ind., will build a 2 story, 40 x 100 ft. factory at West 25th St. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

Leather Factory—Stability Leather Goods Mfg. Co., 2705 Olive St., St. Louis, Mo., is having preliminary plans prepared for the construction of a leather goods factory at Galveston, Tex. Estimated cost $100,000. Private plans.

Oil Packing House—Freedom Oil Works Co., E. J. Bischofberger, Gen. Mgr., Freedom, Pa., having plans prepared for construction of 3 story, 60 x 120 ft., oil packing house to replace fire loss. Estimated cost $100,000. J. Martsolf, New Brighton, is architect.

Oil Plant—Gulf Refining Co., Frick Annex, Pittsburgh, Pa., will soon award contract for marine-rail bulk oil distribution plant on Monongahela River near Dorono, Pa. Estimated cost $100,000.

Oil Producing Equipment—Imperial Oil Ltd., C. Lever, Ch. Engr., Sarnia, Ont., plans to expend $1,000,000 for new oil producing equipment in refinery for special processes to include cracking coils, stills, etc. Work will start soon. Interested in prices on all equipment.

Petroleum Products Plant—American Mineral Spirits Co., 205 East 42nd St., New York, N. Y., postponed construction of petroleum products plant, also tanks at Carteret, N. J. $40,000. Architect not announced. Maturity indefinite.

Refinery (Oil)—Houston Oil Co. of Texas, Petroleum Bldg., Houston, Tex., plans enlargement of present oil refinery to double capacity, also installation of equipment, etc., at Viola near Pettus. Private plans.

Refinery (Oil)—J. Sanger, San Angelo, Tex., has purchased a plant at Pioneer near San Angelo and will install new equipment to cost $90,000.

Refinery (Oil)—Everybody's Independent Refining Co., c/o R. J. Worthington, Mineola, Tex., plans construction of refinery, 2,500 bbl. capacity, also plans construction of a 4 in. pipe line from Gladewater to Mineola to supply refinery. Contracts will soon be let. Estimated cost $150,000.

Refinery (Oil)—Allegany Refining Co., c/o W. E. Sawyer, Bolivar, N. Y., is having plans prepared for the construction of an oil refinery, 500 bbl. capacity. Estimated cost $200,000. H. Ross, Warren, Pa., is engineer.

Refinery (Oil)—All-States Refining Co., Thrall Tex., acquired a site and plans the construction of a skimming plant, 3,000 bbl. capacity near Overton. Estimated cost $50,000. Private plans.

Refinery (Oil)—R. E. Burnet & Associates, Gladewater, Tex., plans the construction of a refinery, 5,000 bbl. capacity. Estimated cost $140,000. Private plans.

Refinery (Oil)—Kendall Refining Co., Bradford, Pa., awarded contract for a cracking unit 1,250 bbl. daily capacity, to A. G. McKee & Co., 2422 Euclid Ave., Cleveland, O. Estimated cost $350,000.

Paper Plant—Superior Paper Products Co., Carnegie, Pa., will soon award contract for the construction of first unit of paper products plant, 1 story, 80 x 180 ft. Estimated cost $50,000. Braziell & Anderson, 309 4th Ave., Pittsburgh, Pa., are architects.

Pulp Mill, etc.—Lone Star Timber, Lumber & Pulp Co., B. A. Grover, Pres., Pioneer Drug Co. Bldg., Seattle, Wash., making plans for the construction of a pulp mill, saw mill, shingle mill and veneer plant at Port Renfrew, Vancouver Island, B. C. Estimated cost between $6,000,000 and $8,000,000. Work expected to start within 90 days.

Rayon Factory—Princeton Rayons, Inc., 150 Madison Ave., New York, N. Y., will not build factory at Scranton, Pa. Project abandoned. Owner purchased plant at Waterbury, Conn. Minor alterations will be made and equipment required at new plant.

Rubber Factory—Panther Rubber Co., 56 Monks St., Stoughton, Mass., will build a 2 story, 60 x 84 and 50 x 160 ft. factory. Estimated cost $40,000. Schein & Levine, 333 Washington St., Boston, are architects. Work will be done by owner's forces.

Rubber Factory—Rand Rubber Co., Haley St. and Sumner Ave., Brooklyn, N. Y., awarded contract for alterations to factory to Sracer & Tueru, c/o owner. Estimated cost $40,000.

Varnish Factory—Hilo Varnish Co., Marcy and Flushing Aves., Brooklyn, N. Y., awarded contract for 80 x 200 ft. factory on Stewart Ave., Ingram St. and Harrison Pl., to Turner Constr. Co., Graybar Bldg., New York. Estimated cost $125,000.

Zinc Sulphide Works—New Jersey Zinc Co., 160 Front St., New York, having plans made for additions and equipment to plant at Palmerton, Pa. Estimated cost $150,000.

INDUSTRIAL NOTES

CUTLER-HAMMER, INC., Milwaukee, has appointed D. J. Quammen manager of the Philadelphia office, to succeed F. J. Burd, who has become manager of the Chicago office.

ARMSTRONG CORK Co., Lancaster, Pa., has consolidated all its Boston offices in one building at 286 Congress St.

PRESSED STEEL TANK CAR Co., New York City, has appointed P. T. Babcock to take complete charge of sales with headquarters at Milwaukee, Wis.

MOELLER INSTRUMENT Co., Brooklyn, N. Y., has made the following appointments: P. D. Rech, Elkins, Pa.; E. C. Shriner, South Hills, Pittsburgh, Pa.; and Paper Mill Equipment Co., Northwestern Bank Bldg., Portland, Ore.

HILTON STEEL Co., Warren, Ohio, has been organized as a firm of engineers and fabricators under J. L. Hilton, president: A. F. Steele, secretary; and R. A. Zeyfang.

LUKENWELD, INC., has appointed W. R. McDonough & Co. representatives at Cleveland and the Dravo Doyle representative in Pittsburgh.

BLAW-KNOX Co. has appointed Roger W. Andrews vice-president and director of the Blaw-Knox International Corp., with residence in Paris, to succeed C. T. Clack, who died recently in Germany.

FUSION WELDING CORP., Chicago, has appointed the Puritan Compressed Gas Corp. as distributor in the territory adjacent to its offices at Kansas City, Mo.

GOULDS PUMPS, INC., Seneca Falls, N. Y., has appointed Henry F. Miller manager of industrial sales, W. G. Allen manager of engineering sales, M. D. Rowe manager of the New York office, J. B. Foley manager of Chicago office, and F. Jones manager of the Pittsburgh office.

CEMENT GUN CONSTRUCTION Co., Chicago, has moved its New York office to the Woolworth Building.

PORCELAIN ENAMEL INSTITUTE, 612 North Michigan Ave., Chicago, has added a manufacturers' technical consultation service to its activities for the benefit of manufacturers interested in the use of porcelain enamel on their products.